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Oracle Database Backup-and-Recovery

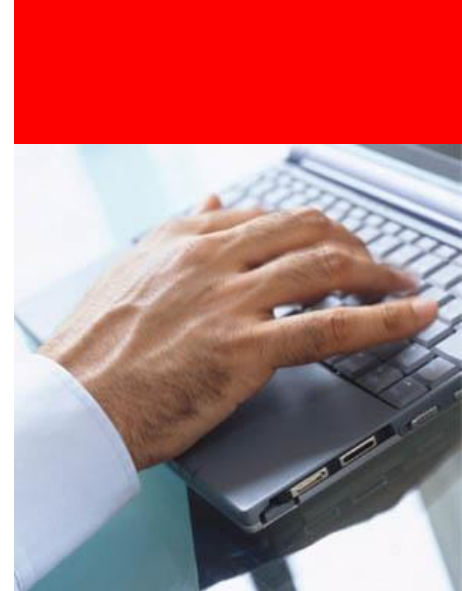
Instructor:
Dr.Baraani

Creator:
Mohammad Sadegh Salehi



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

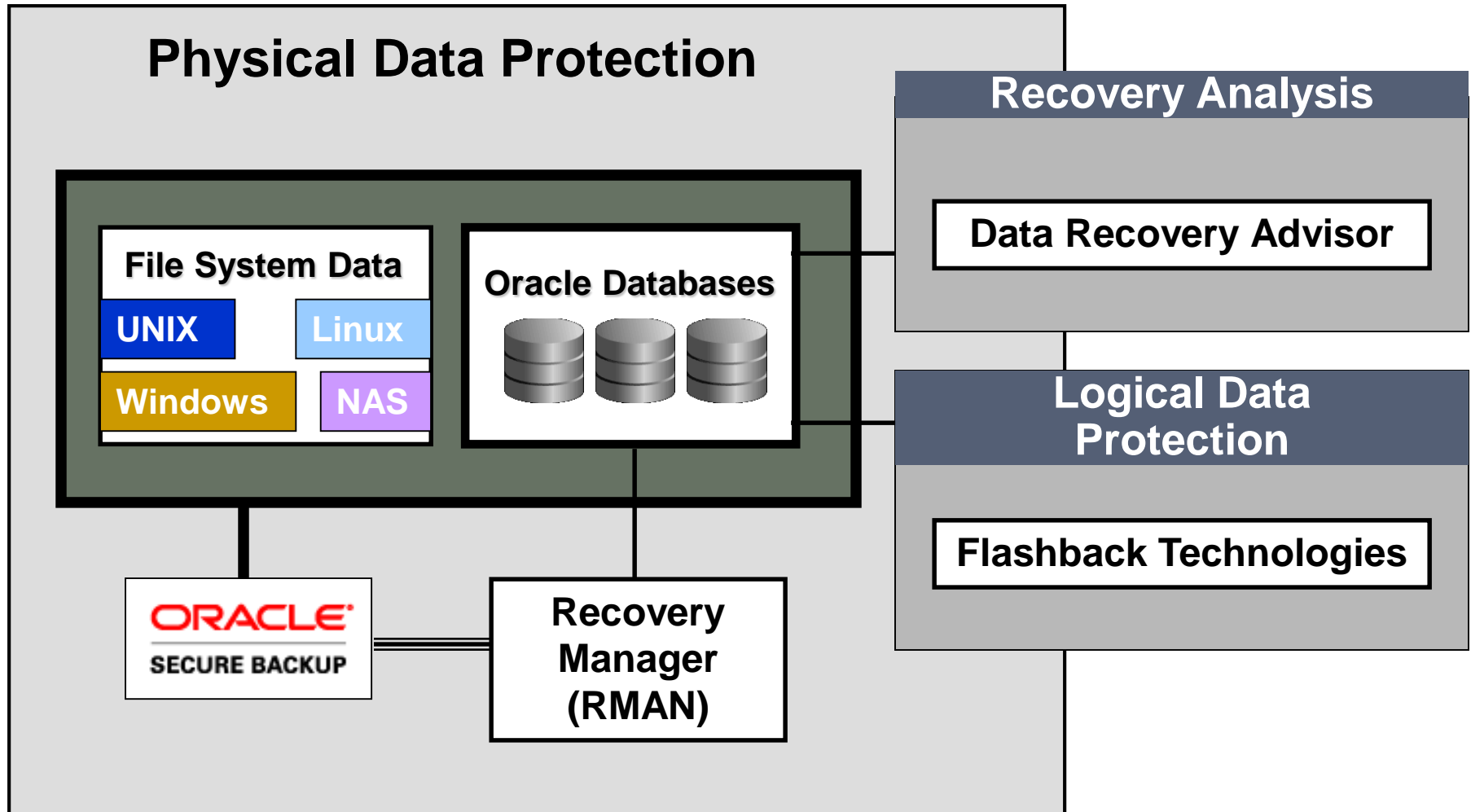
Snapshots, Replication, Archive, Analytics





Oracle Backup & Recovery Solutions

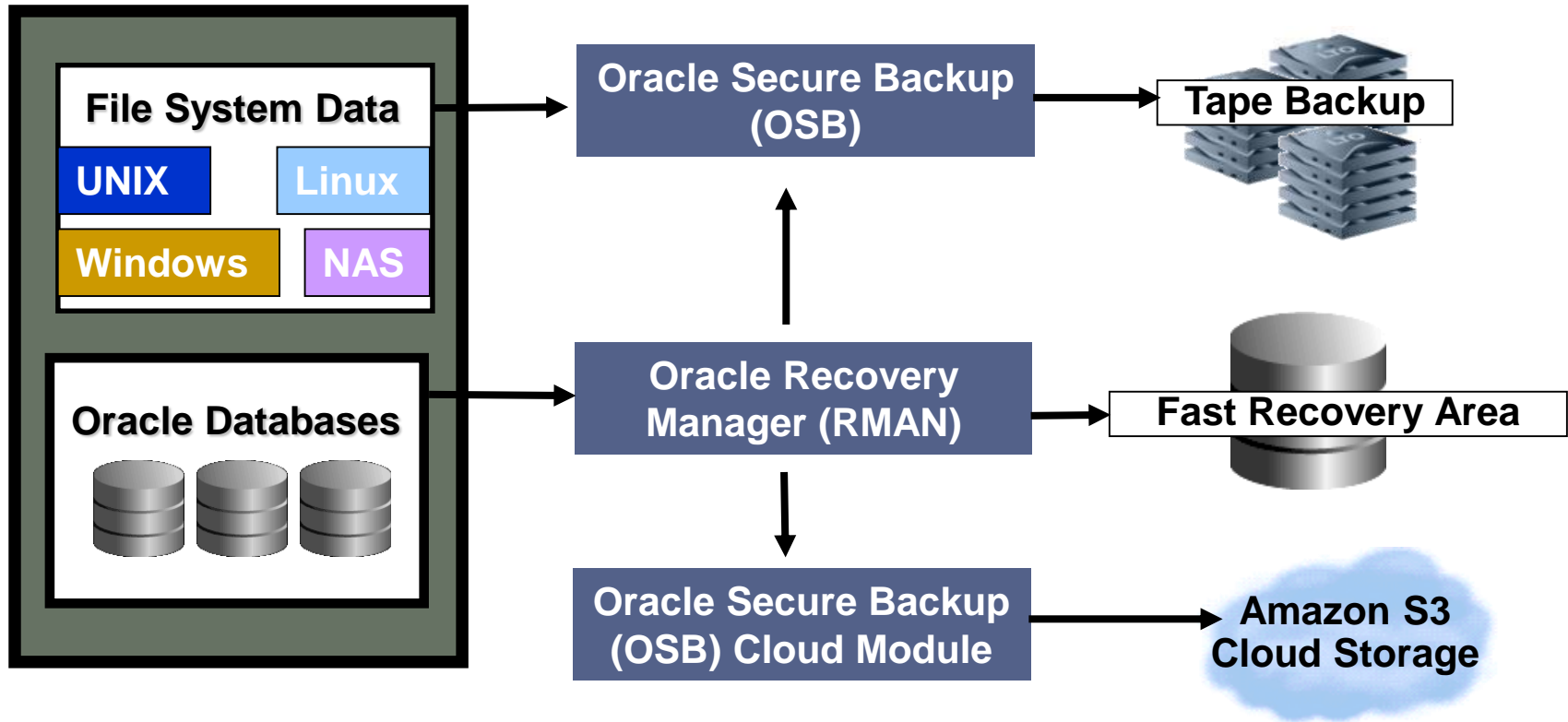
“Backup and Recovery on Steroids”





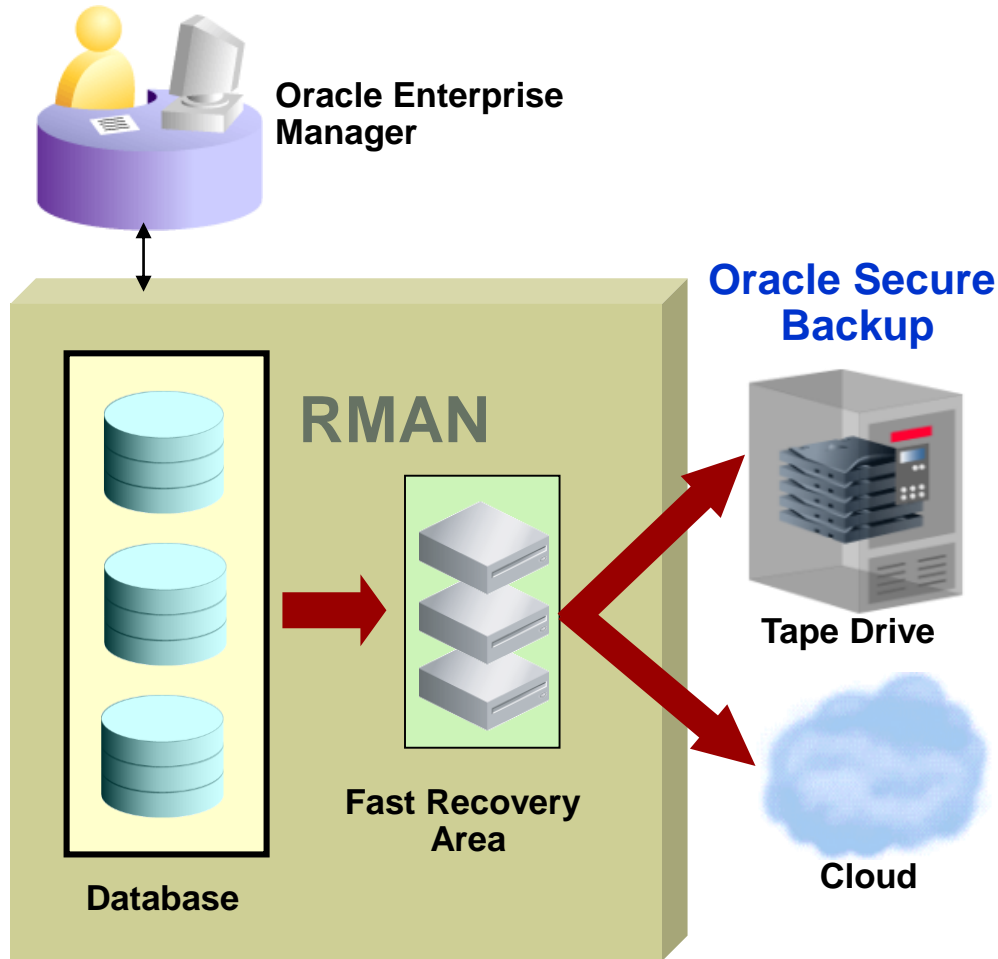
Backup & Recovery Foundation

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.

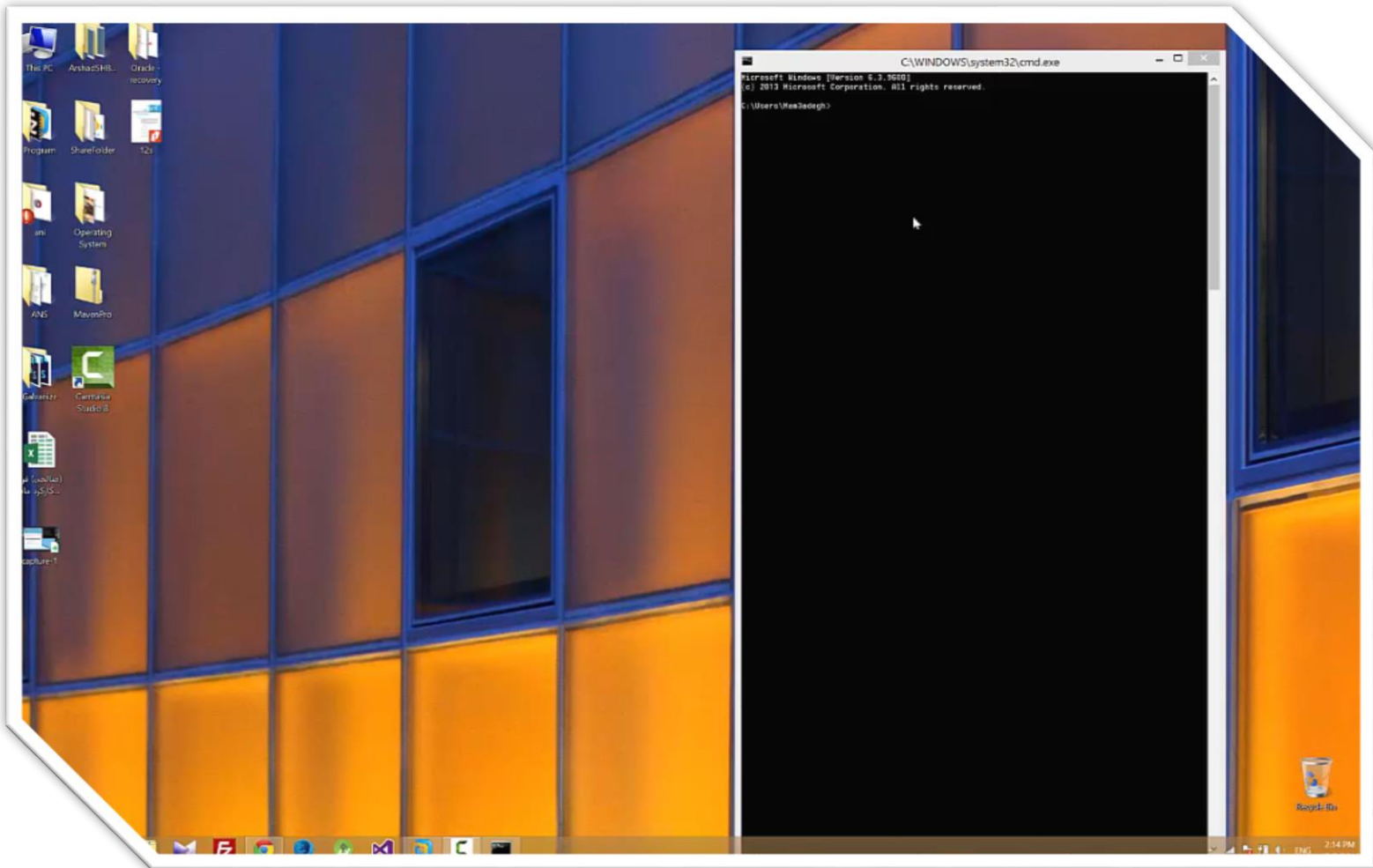


Feature Comparison of Backup Techniques

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





Change RMAN Backup Configuration

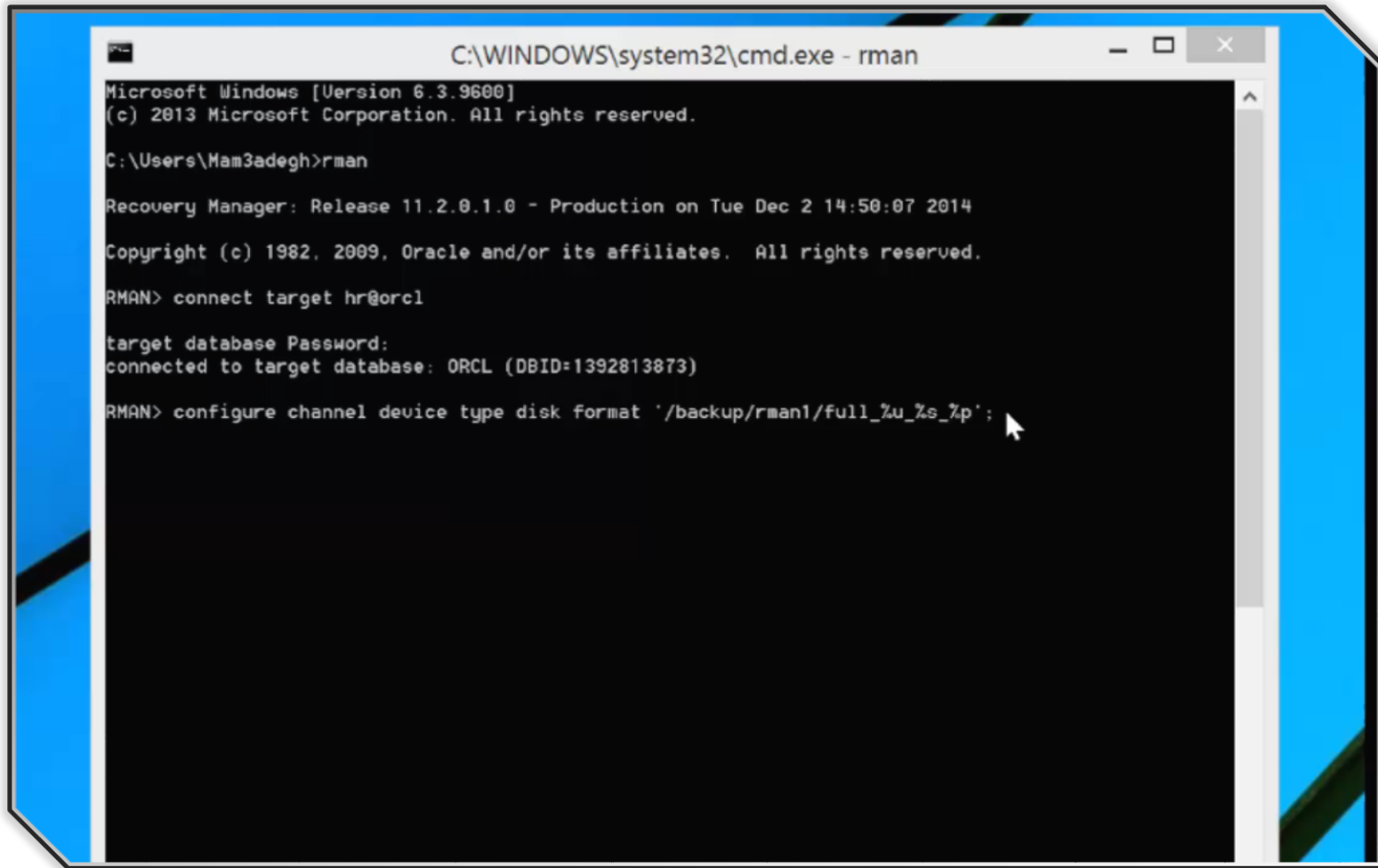
```
RMAN> CONFIGURE CHANNEL DEVICE TYPE DISK FORMAT '/backup/rman/full_%u_%s_%p';
```

```
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



```
C:\WINDOWS\system32\cmd.exe - rman
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Mam3adeqh>rman

Recovery Manager: Release 11.2.0.1.0 - Production on Tue Dec 2 14:50:07 2014

Copyright (c) 1982, 2009, Oracle and/or its affiliates. All rights reserved.

RMAN> connect target hr@orcl

target database Password:
connected to target database: ORCL (DBID=1392813873)

RMAN> configure channel device type disk format '/backup/rman1/full_%u_%s_%p';
```



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

```
C:\WINDOWS\system32\cmd.exe - RMAN

Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\Mam3adeqh>RMAN

Recovery Manager: Release 11.2.0.1.0 - Production on Tue Dec 2 15:35:00 2014

Copyright (c) 1982, 2009, Oracle and/or its affiliates. All rights reserved.

RMAN> CONNECT TARGET HR@ORCL

target database Password:
connected to target database: ORCL (DBID=1392813873)

RMAN> BACKUP AS COMPRESSED BACKUPSET DATABASE;
```



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

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;`

18

```
C:\WINDOWS\system32\cmd.exe - rman
File Status Marked Corrupt Empty Blocks Blocks Examined High SCN
-----
OK 0 255 640 11N2455
File Name: C:\ORACLE\ORADATA\ORCL\USERS01.DBF
Block Type Blocks Failing Blocks Processed
-----
Data 0 91
Index 0 39
Other 0 255

File Status Marked Corrupt Empty Blocks Blocks Examined High SCN
-----
OK 0 1689 1280N 11N8757
File Name: C:\ORACLE\ORADATA\ORCL\EXHMPLED.DBF
Block Type Blocks Failing Blocks Processed
-----
Data 0 658N
Index 0 1261
Other 0 3265

channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
including current control file in backup set
including current SPFILE in backup set
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
List of Control File and SPFILE
-----
File Type Status Blocks Failing Blocks Examined
-----
SPFILE OK 0 2
Control File OK 0 594
Finished backup at 02-DEC-14

RMAN>
```



Recover Database - RMAN

```
SQL> select * from employee;

EMPNO EMPNAME          SALARY
-----
111 Tom                1727

SQL> commit;

Commit complete.

SQL> archive log start=true;
SP2-0716: invalid combination of ARCHIVE LOG options
SQL> log_archive_start = true;
SP2-0734: unknown command beginning "log_archiv..." - rest of line ignored.
SQL> set autorecovery on;
SQL> recover database;
ORA-00905: missing keyword

SQL> startup mount;
ORA-01081: cannot start already-running ORACLE - shut it down first
SQL> shutdown immediately;
SP2-0717: illegal SHUTDOWN option
SQL> shutdown immediat;
SP2-0717: illegal SHUTDOWN option
SQL> shutdown immediately;
SP2-0717: illegal SHUTDOWN option
SQL> shutdown immediate;
Database closed.
Database dismounted.
```



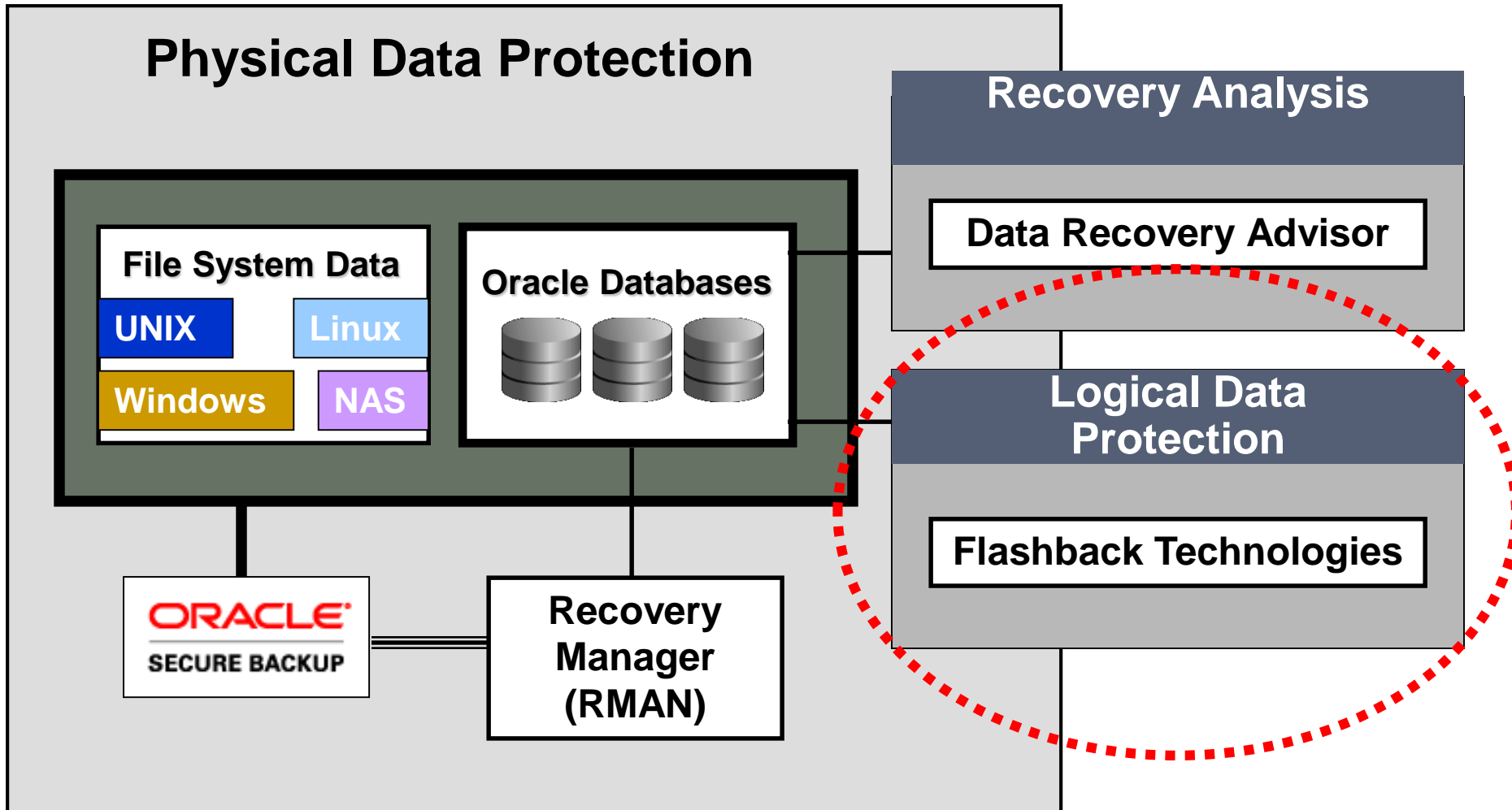
Additional Resources

- 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

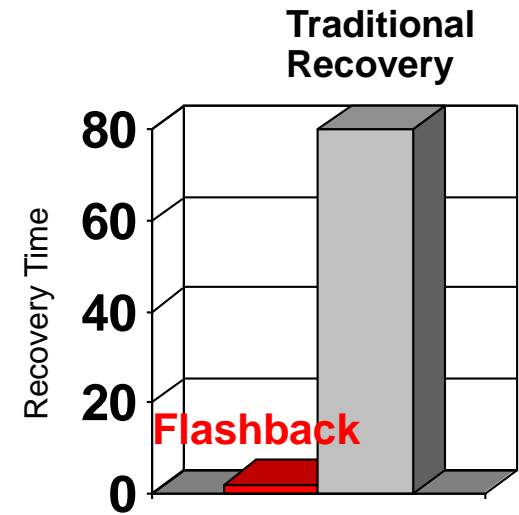




Flashback Technologies

Error Detection & Correction

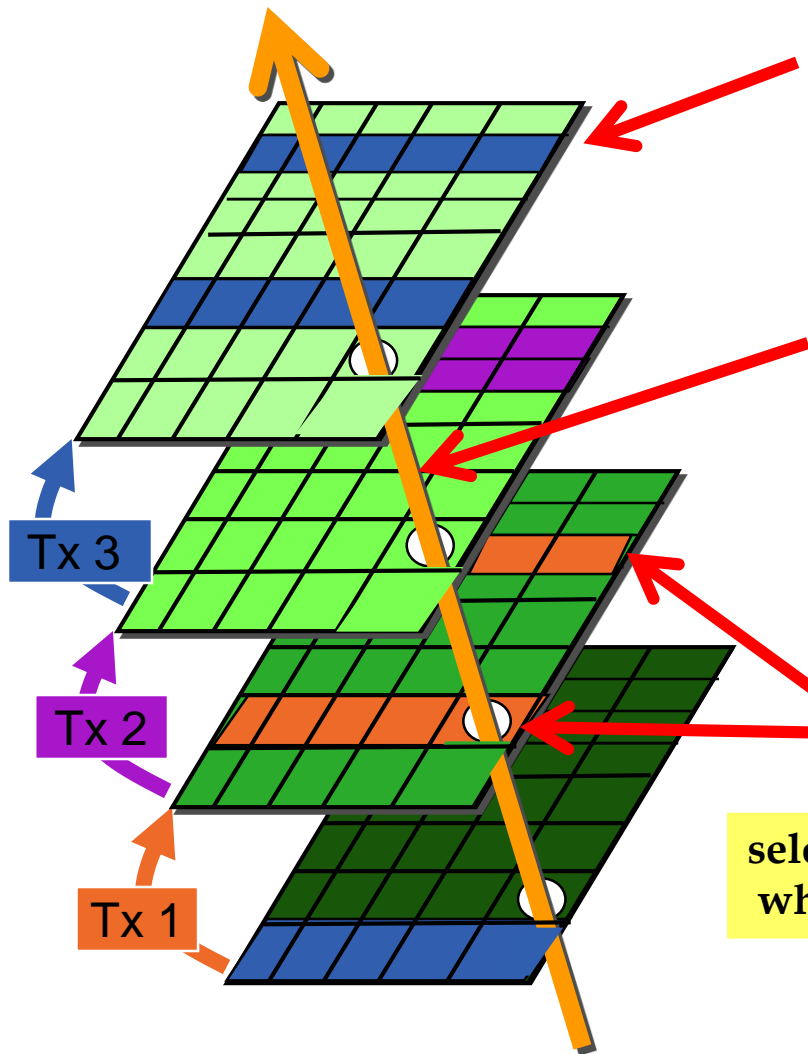
- Flashback revolutionizes error recovery
 - View 'good' data as of a past point-in-time
 - Simply rewind data changes
 - Time to correct error equals time to make error



$$\text{Correction Time} = \text{Error Time} + \cancel{f(\text{DB_SIZE})}$$

- 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.

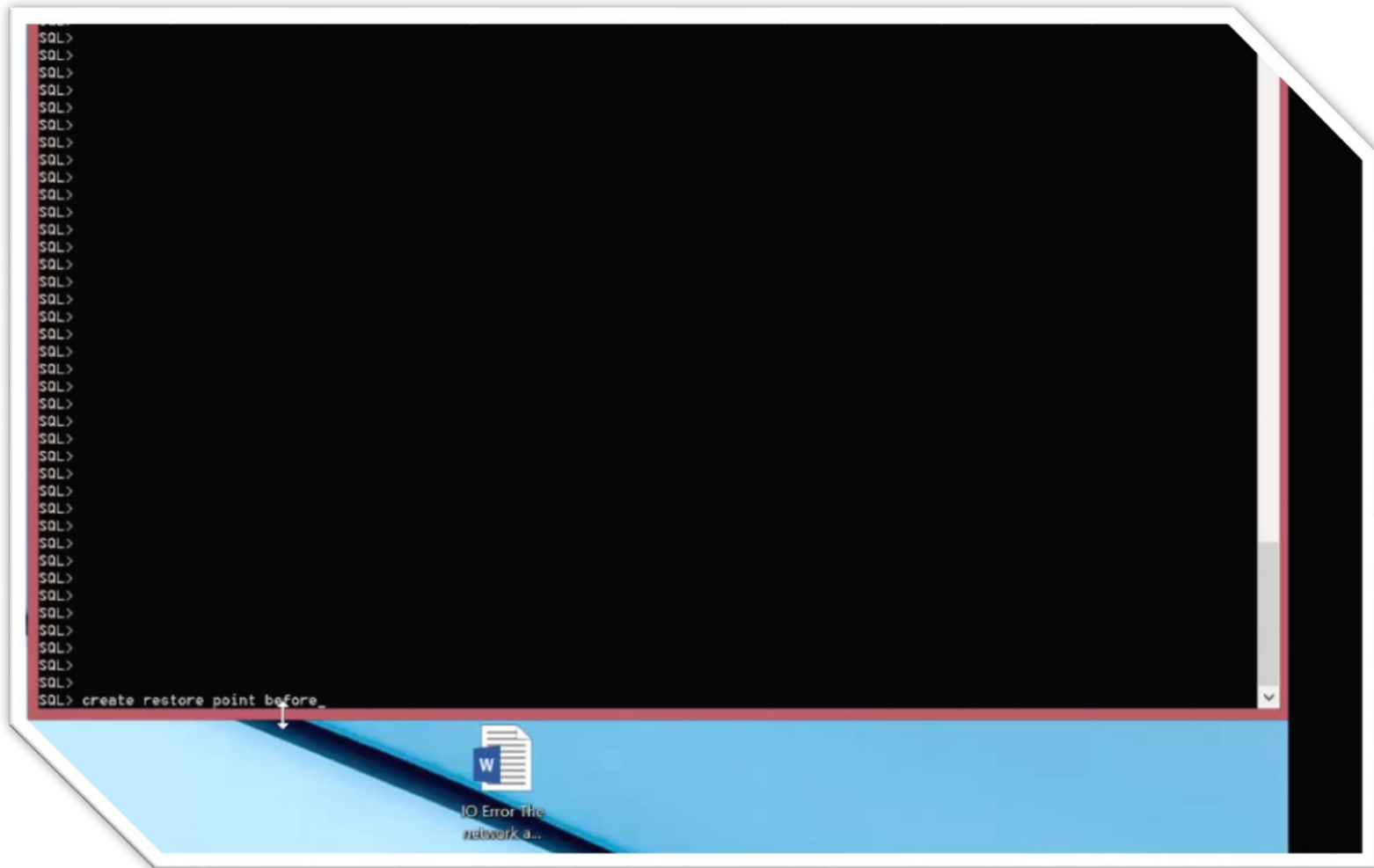


Rewinding a Database with Flashback Database

```
*  
ERROR at line 2:  
ORA-00922: missing or invalid option  
  
SQL> alter system set DB_RECOVERY_FILE_DEST_SIZE = 1G;  
System altered.  
  
SQL> alter system set DB_RECOVERY_FILE_DEST_SIZE = 1G;  
System altered.  
  
SQL> alter system set DB_RECOVERY_FILE_DEST = '/backup';  
System altered.  
  
SQL>
```



Using Normal and Guaranteed Restore Points





Flashback Example

le has one version of one row

om table

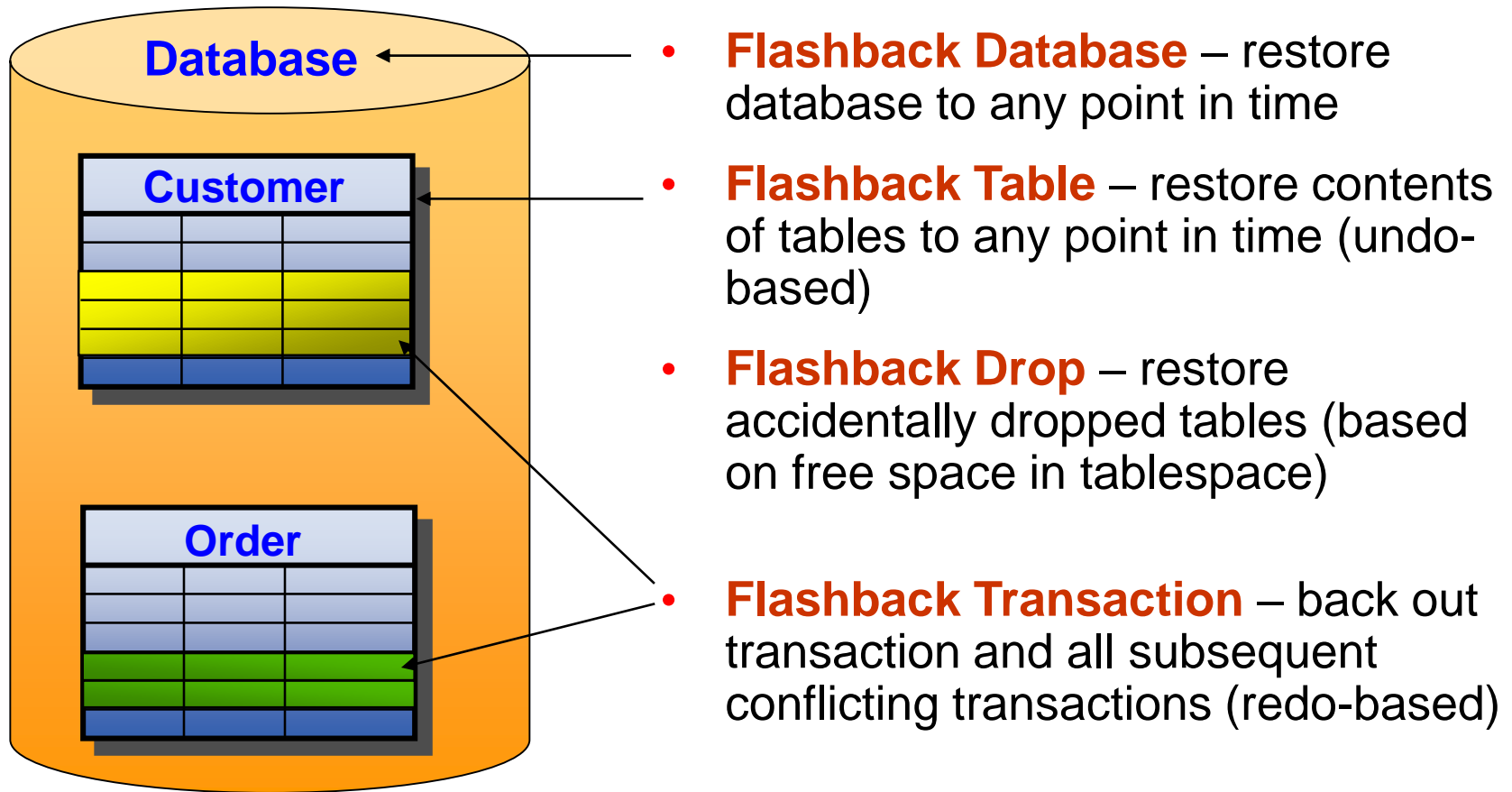
name into the emp table.

blem. The DBA issues the f

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);
```

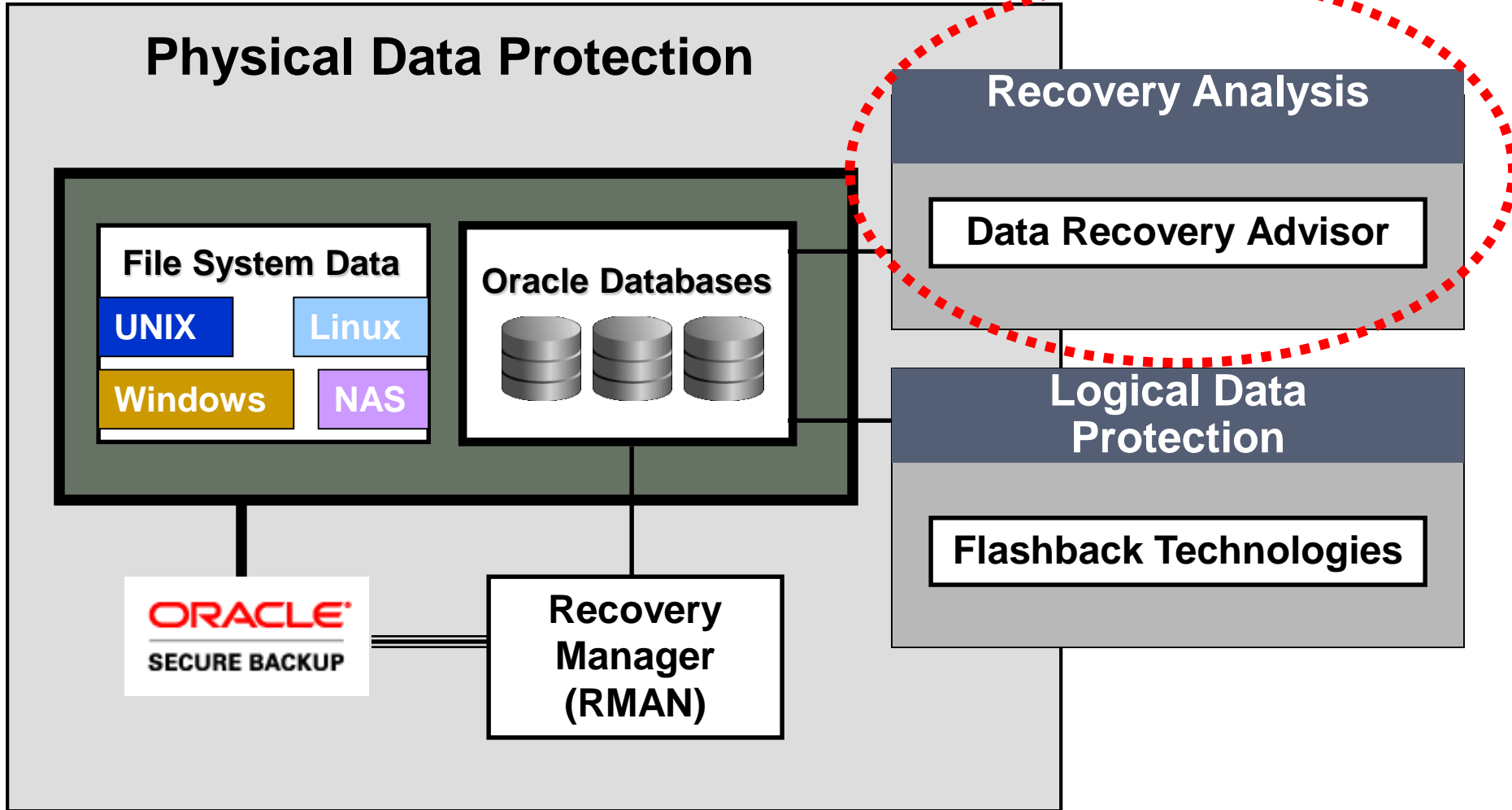
Error Correction with Flashback





Recovery Analysis

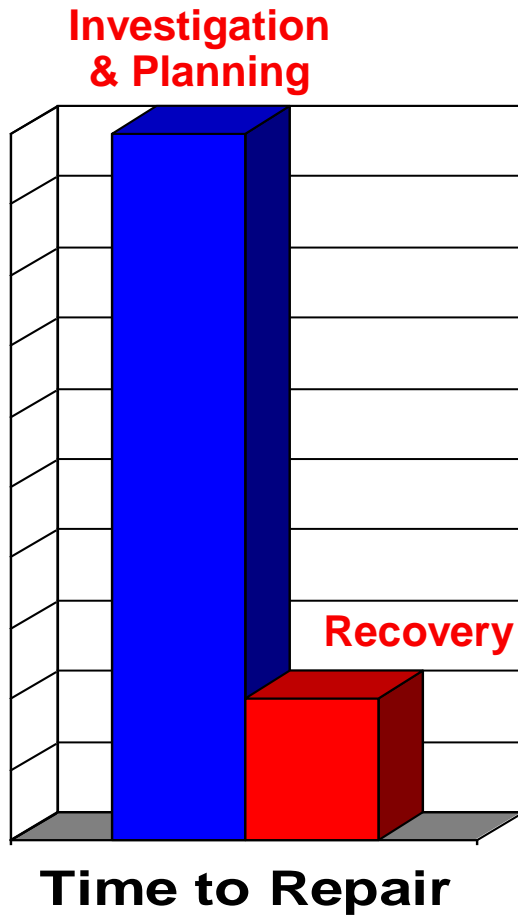
Intelligent, Guided Recovery





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



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

ORACLE Enterprise Manager 10g
Grid Control

HomeTargetsDeploymentsAlertsSetup Preferences Help Logout
ComplianceJobsReports

Hosts | Databases | Middleware | Web Applications | Services | Systems | Groups | All Targets

Database Instance: NewYork.us.oracle.com >

i Information

- [Database Failures](#) - 1
- [Current Status](#) - MOUNTED

Perform Recovery

Oracle Advised Recovery

The Data Recovery Advisor has detected failures. Click on "Advise and Recover" to have Oracle analyze and produce recovery advice.

Failures Detected **Critical: 0 High: 1 Low: 0**
Failure Description **One or more non-system datafiles are missing**

[Advise and Recover](#)

User Directed Recovery

Recovery Scope Whole Database [Recover](#)

Operation Type ☒ Recover to the current time or a previous point-in-time
Datafiles will be restored from the latest usable backup as required.
☐ Restore all datafiles
Specify Time, SCN or log sequence. The backup taken at or prior to that time will be used. No recovery will be performed in this operation.
☐ Recover from previously restored datafiles

► Decrypt Backups

Host Credentials

To perform recovery, supply operating system login credentials to access the target database.

i Overview

- Recover database failures as advised by Oracle
- Restore and/or recover the entire database or selected objects
- Restore files to a new location
- Recover tablespaces to a point-in-time based on a timestamp, system change number (SCN), or log sequence number
- Recover datafile data blocks that are marked as corrupted, or based on datafile block IDs or tablespace block addresses
- Flashback database or tables to a specific system change number (SCN) or timestamp

Data Recovery Advisor – View Failures

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Grid Control

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Database Instance: NewYork.us.oracle.com >

View and Manage Failures

Last Refresh March 20, 2009 12:18:44 PM EDT

Select dropdown values and optionally enter failure description and impact strings to filter the data that is displayed in your results set.

Failure Description Impact Priority Status Time Detected
 CRITICAL or HIGH OPEN All

Select failures and ...

Select All | Select None | Expand All | Collapse All

Select	Failure Description	Impact	Priority	Status	Time Detected
<input type="checkbox"/>	▼ Data Failures				
<input checked="" type="checkbox"/>	▼ One or more non-system datafiles are missing	See impact for individual child failures	HIGH	OPEN	2009-03-20 12:15:27.0
<input checked="" type="checkbox"/>	Datafile 5: /private3/oracledg/oradata/NewYork/example01.dbf is missing	Some objects in tablespace EXAMPLE might be unavailable	HIGH	OPEN	2009-03-20 12:15:27.0

☒ **TIP** All CRITICAL failures must be selected before "Advise". All CRITICAL failures must be unselected before "Set Priority High" or "Set Priority Low".

Related Links

[Checkers](#)

Home | Targets | Deployments | Alerts | Compliance | Jobs | Reports | Setup | Preferences | Help | Logout

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Data Recovery Advisor – Manual Repair

The screenshot displays the Oracle Enterprise Manager 10g Grid Control interface. At the top, the Oracle logo and 'Enterprise Manager 10g Grid Control' are visible. A navigation bar includes links for Home, Targets, Deployments, Alerts, Setup, Preferences, Help, and Logout. Below this, a secondary navigation bar lists Hosts, Databases, Middleware, Web Applications, Services, Systems, Groups, and All Targets. The main content area is titled 'Database Instance: NewYork.us.oracle.com' and 'Manual Actions'. It features three buttons: 'Cancel', 'Re-assess Failures', and 'Continue with Advise'. A text block explains that user actions can provide a faster recovery path for certain failures and instructs the user to click 'Re-assess Failures' if they perform actions, or 'Continue with Advise' to use the generated advice. Below this is a section titled 'Manual Action Details' with a message: 'If file /private3/oracledg/oradata/NewYork/example01.dbf was unintentionally renamed or moved, restore it'. This section also includes the same three buttons. At the bottom, there is a footer with copyright information (© 1996, 2009, Oracle and/or its affiliates) and a link to 'About Oracle Enterprise Manager'.

ORACLE Enterprise Manager 10g
Grid Control

Home Targets Deployments Alerts Setup Preferences Help Logout
Compliance Jobs Reports

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Database Instance: [NewYork.us.oracle.com](#) >

Manual Actions

Cancel Re-assess Failures Continue with Advise

The following user actions may provide a faster recovery path for certain simple failures. Click "Re-assess Failures" if user actions are performed. Otherwise, click "Continue with Advise" to use the recovery advice generated for the failures selected.

Manual Action Details

If file /private3/oracledg/oradata/NewYork/example01.dbf was unintentionally renamed or moved, restore it

Cancel Re-assess Failures Continue with Advise

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Thanks,

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