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Oracle Database Backup-and-Recovery Best Practices and New Features

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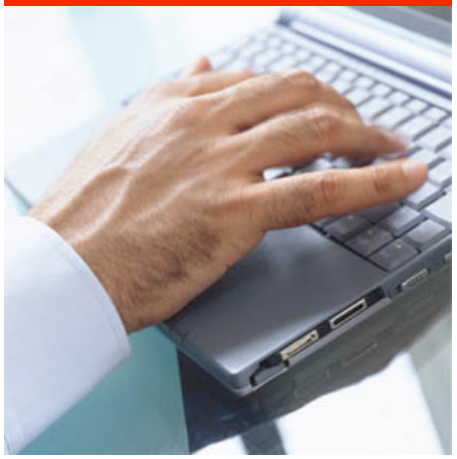
Agenda



- What Keeps You Awake at Night?
- Oracle Data Protection Planning & Solutions
- Oracle Backup & Recovery Solutions
  - Physical Data Protection
    - Recovery Manager
    - Oracle Secure Backup
  - Logical Data Protection
    - Flashback Technologies
  - Recovery Analysis
    - Data Recovery Advisor
  - Putting It All Together: Customer Example
- Turkcell Backup & Recovery Case Study
- Q&A

What Keeps You Awake at Night?

Data Protection Concerns…

- Meeting recovery SLAs?
- Reducing exposure to data loss?
- Meeting backup windows?
- Dealing with long-term backup storage?
- Management complexity?
- Budget?

…Where do I begin?

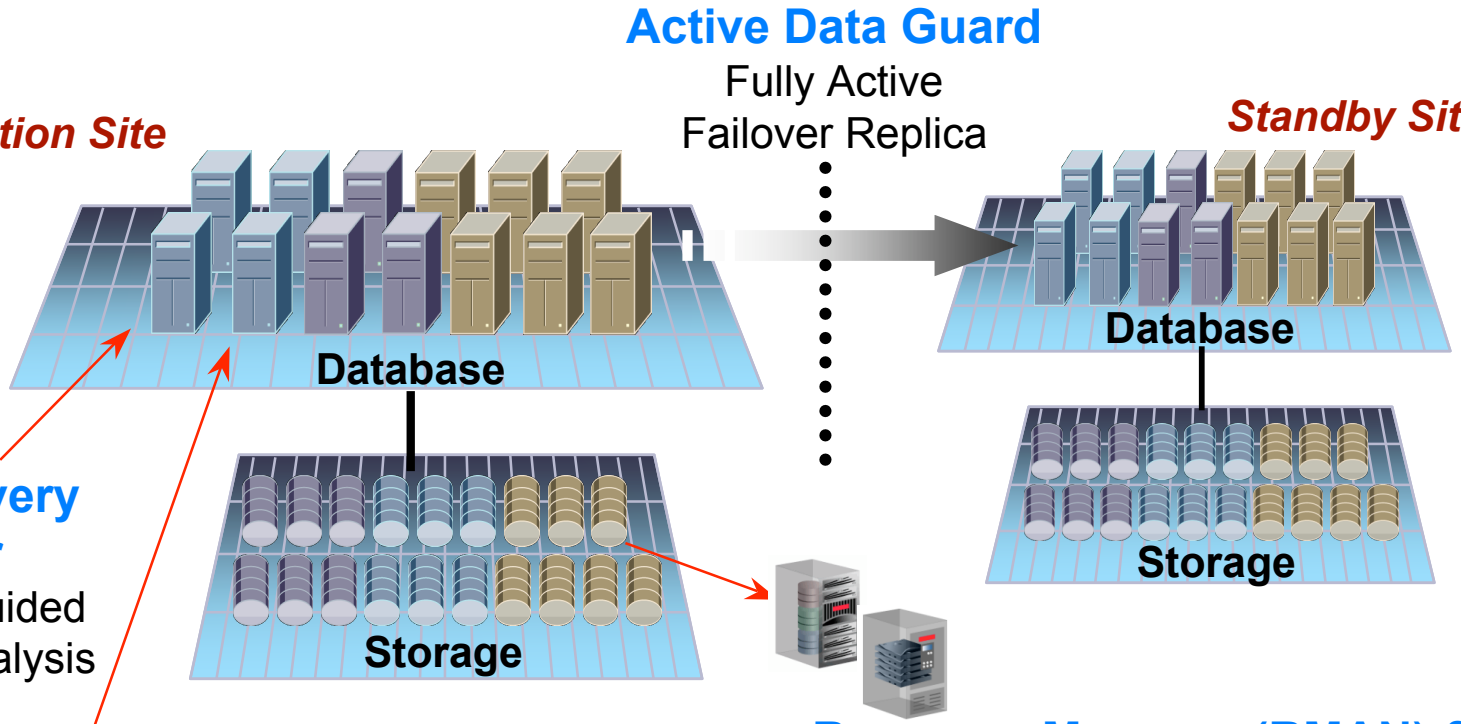
Assess Recovery Requirements

First Step in Data Protection Planning

- Identify and prioritize critical data
- Design recovery requirements around data criticality
  - Assess tolerance for data loss - *Recovery Point Objective (RPO)*
    - How frequently should backups be taken?
    - Point-in-time recovery required?
  - Assess tolerance for downtime - *Recovery Time Objective (RTO)*
    - Downtime: Problem identification + recovery planning + systems recovery
    - Tiered RTO per level of granularity, e.g. database, tablespace, table, row
  - Determine backup retention policy
    - Onsite, offsite, long-term
- Assess data protection requirements
  - Physical: Disasters, outages, failures, corruptions
  - Logical: Human errors, application errors

Oracle Maximum Availability Architecture

Robust & Integrated Data Protection



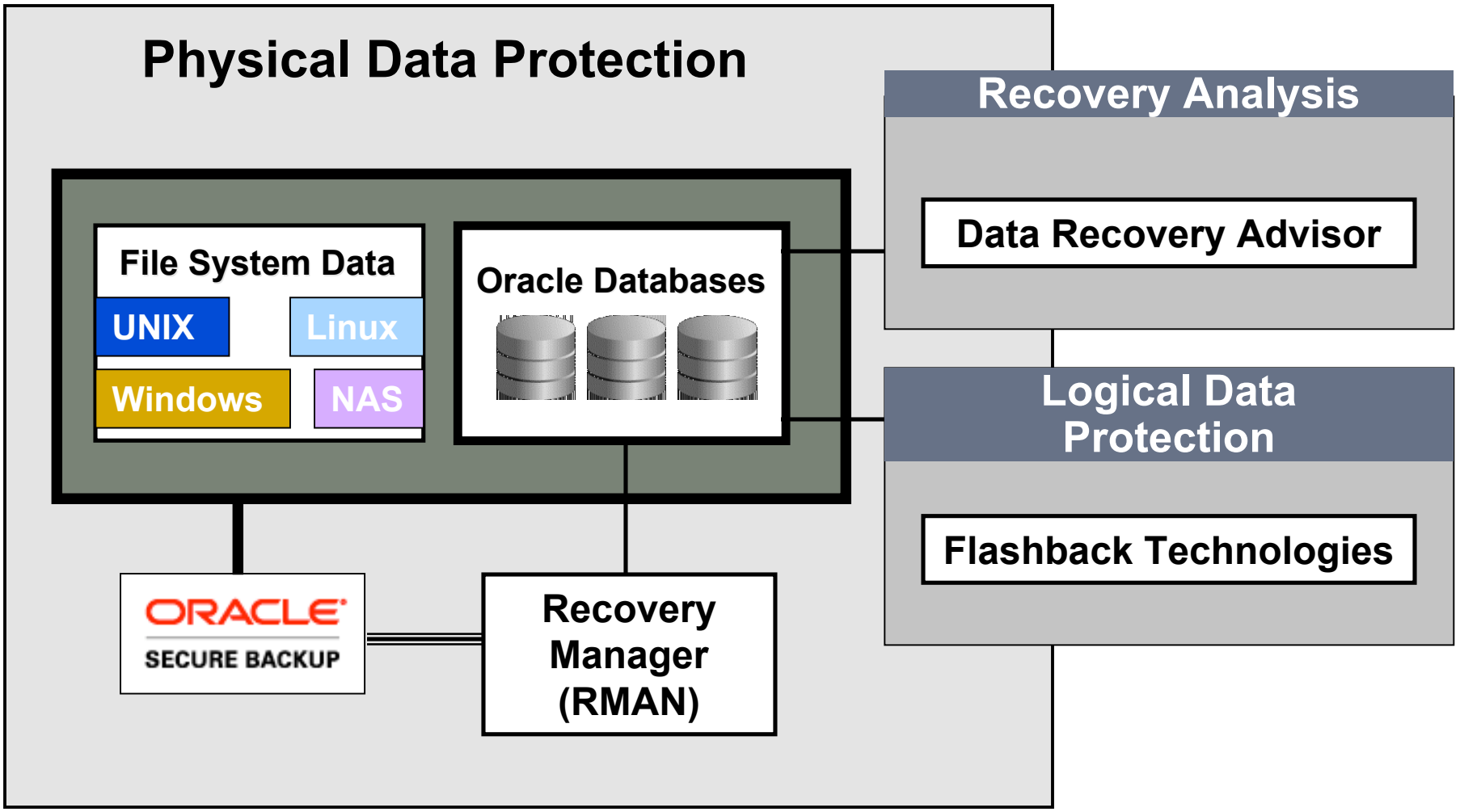
Oracle Data Protection Solutions

Backup & Recovery	Recovery Time Objective (RTO)
Physical Data Protection • Recovery Manager (RMAN) • Oracle Secure Backup (OSB)	Hours/Days
Logical Data Protection • Flashback Technologies	Minutes/Hours
Recovery Analysis • Data Recovery Advisor	Minimizes time for problem identification & recovery planning

Disaster Recovery	Recovery Time Objective (RTO)
Physical Data Protection • Active Data Guard	Seconds/Minutes

Oracle Backup & Recovery Solutions

"Backup and Recovery on Steroids"



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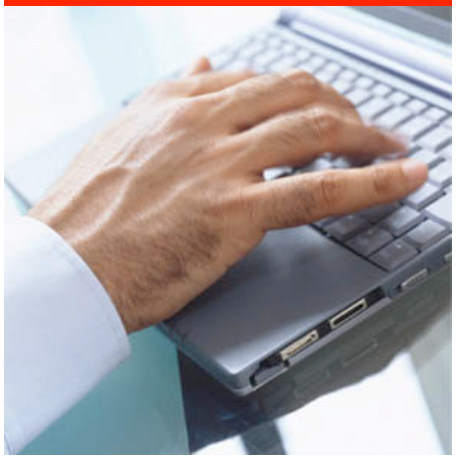

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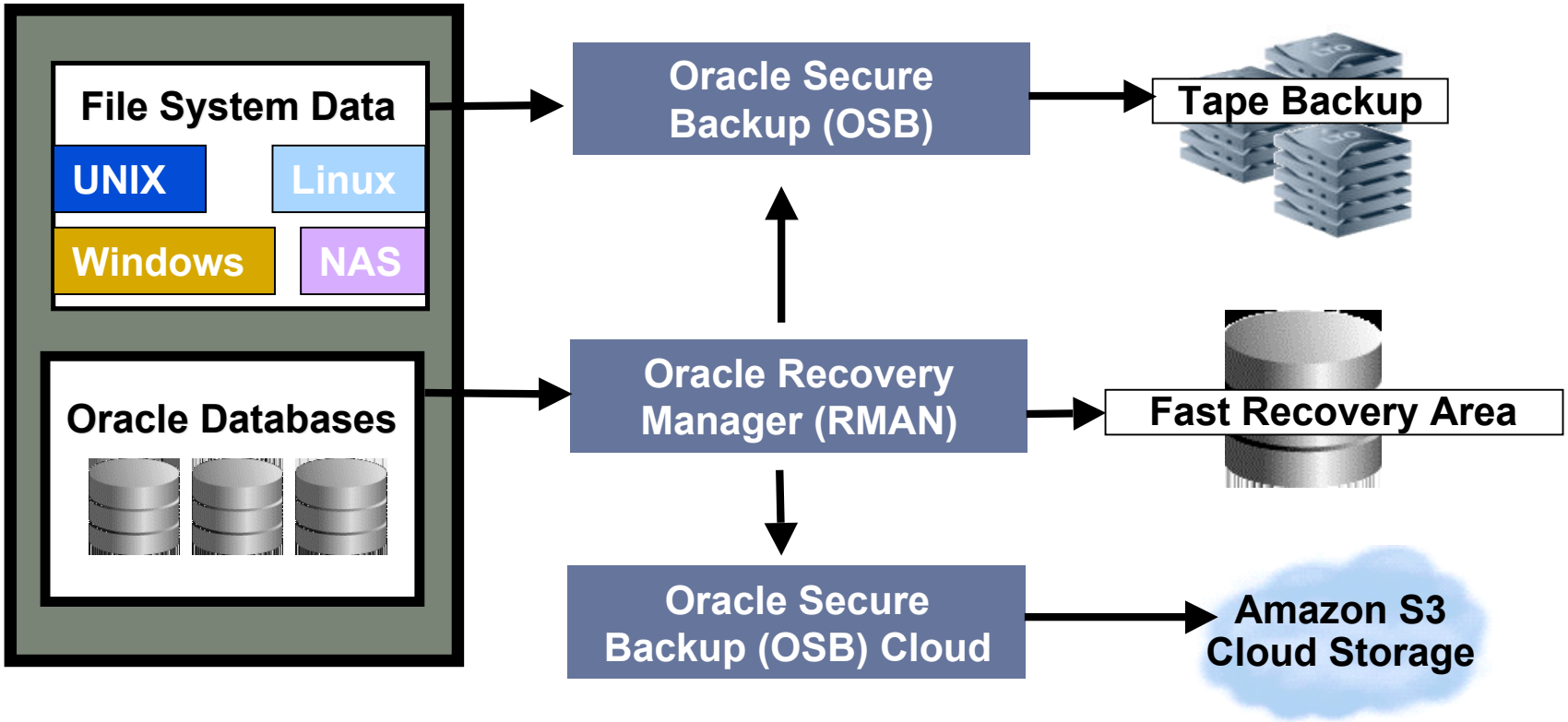
Backup & Recovery Foundation

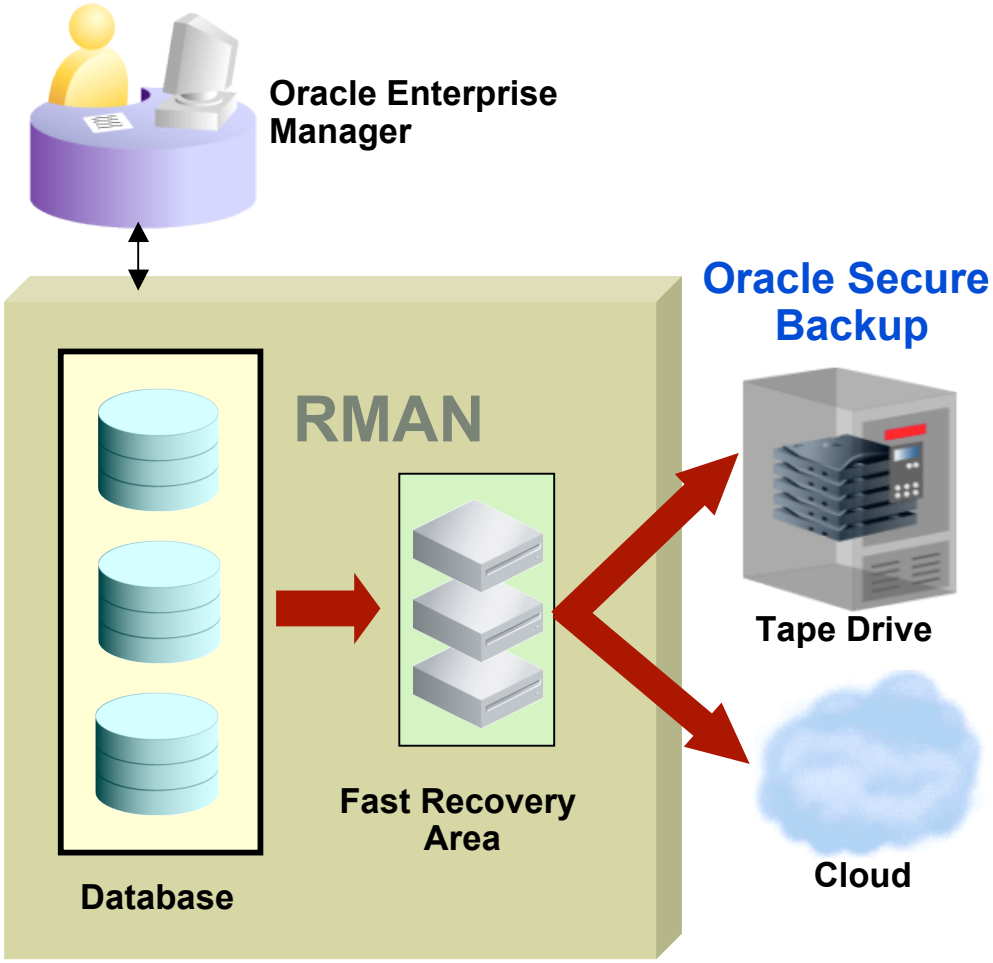
Complete Oracle Solution from Disk to Tape



- Oracle backup and recovery for your entire IT environment
- Multiple media options available to meet the most stringent SLAs
  - Local disk, remote Cloud storage, physical and virtual tape

Oracle Recovery Manager (RMAN)

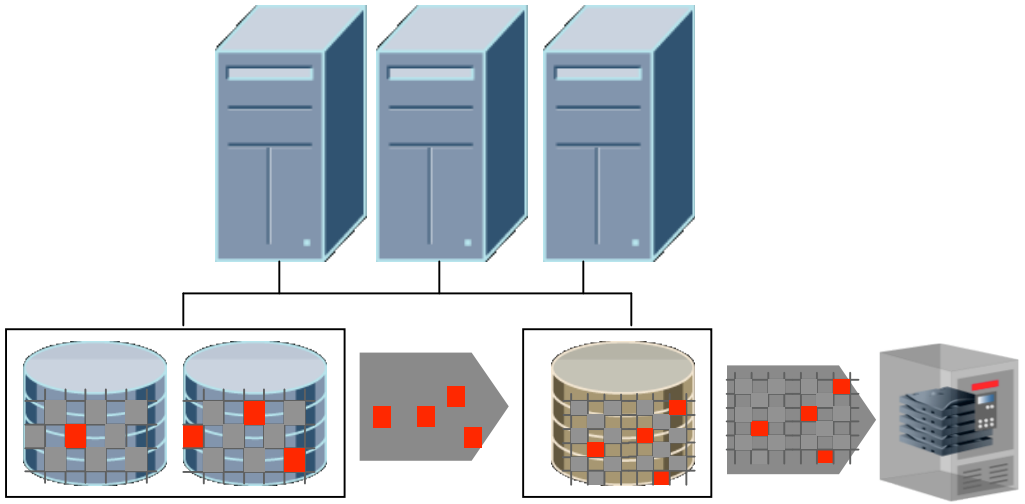
Oracle-integrated Backup & Recovery Engine



- 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 Fast Recovery Area

Automatic Disk-to-Disk (D2D) Backup & Recovery



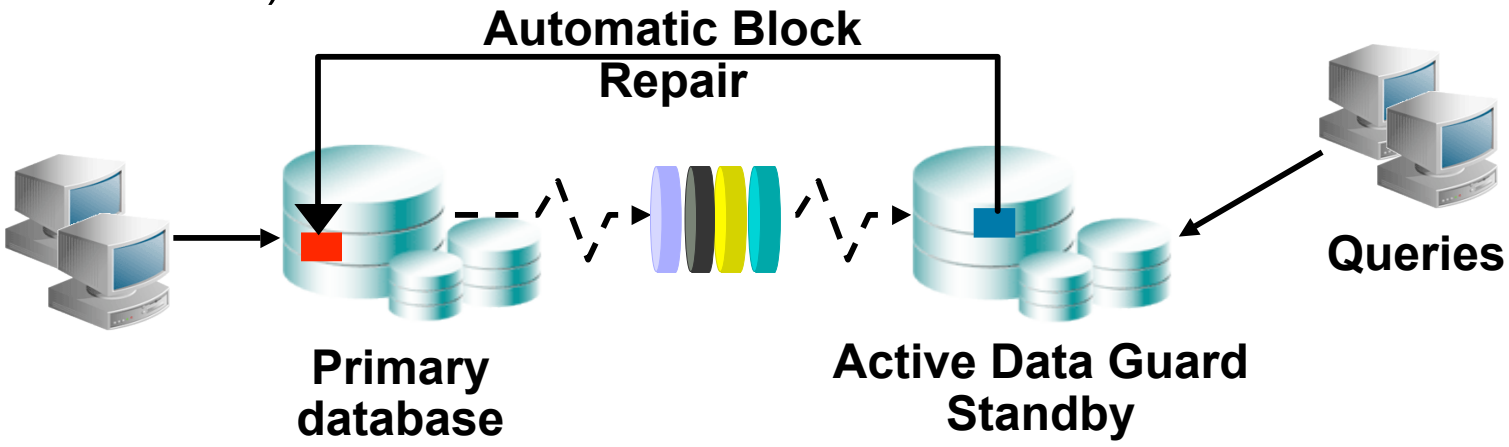
Integrated backup-storage tiering

- Fast Recovery Area – Integrated D2D backup and recovery
  - Favorable disk economics – low-cost disks used for recovery area
  - Oracle makes it even better with ‘ ‘restore-free recovery’:
    - `switch datafile 4 to copy;`
    - `recover datafile 4;`
- Fast incremental backups
  - Backs up only changed blocks
  - Changed blocks are tracked using a very efficient algorithm, e.g. 20X faster
- Nightly incremental backup rolls forward recovery area backup
  - No need to do full backups
    - `recover copy of database with tag 'ORCL';`

RMAN New Features

Oracle Database 11*g* Release 2

- Automatic Block Repair
  - Allows corrupt blocks on the primary database to be automatically repaired from physical standby database, as they are detected.
  - In-line and transparent. User sees brief wait from query on corrupt block while it is being repaired.
  - Can also be performed on-demand via `RECOVER` command
  - Requires Active Data Guard (real-time query on physical standby database).



RMAN New Features

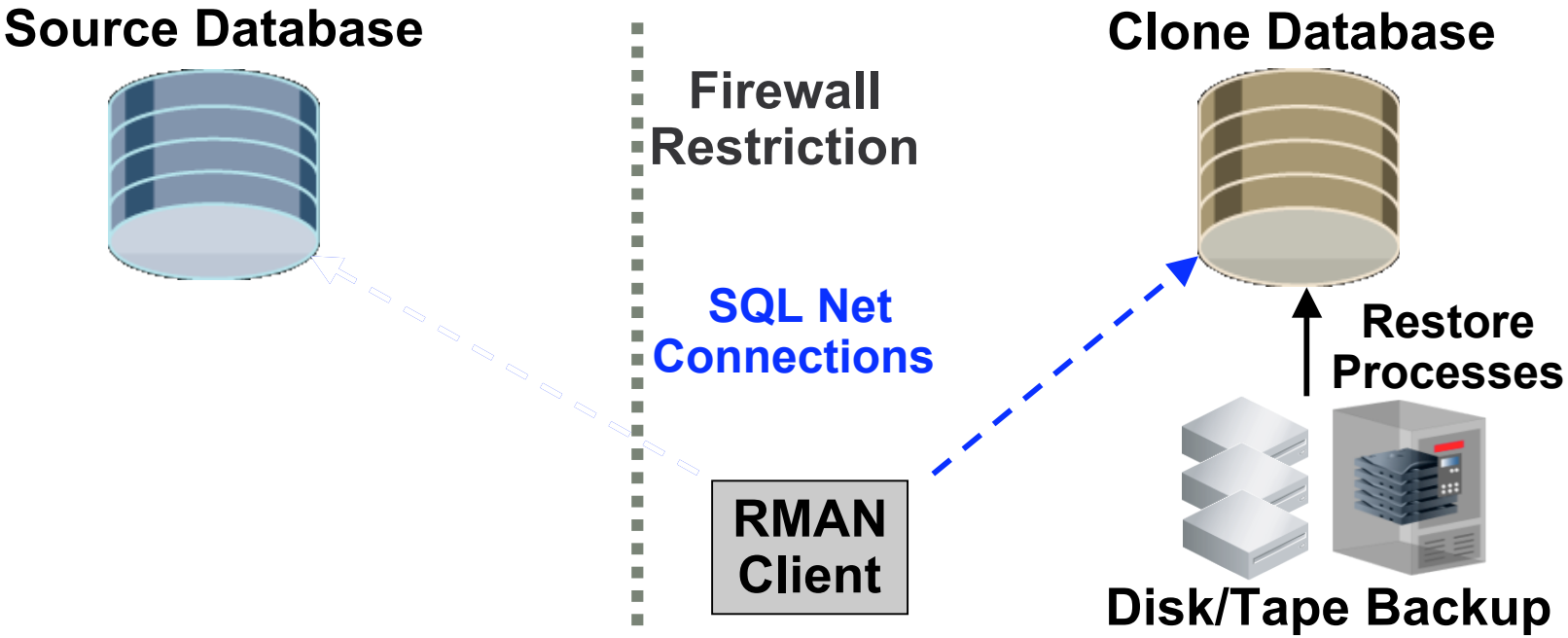
Oracle Database 11*g* Release 2

- Backup compression: popular way to save on storage costs
- Multiple RMAN backup compression levels
  - Choose compression levels & backup throughput
    - **`[BASIC] | HIGH | MEDIUM | LOW`**
    - `HIGH` – reduces backup size by 40%+ depending on data type
    - `LOW` – least impact on backup throughput
    - `MEDIUM` – best balance between compression and throughput
    - `HIGH | MEDIUM | LOW` require Advanced Compression Option

RMAN New Features

Oracle Database 11*g* Release 2

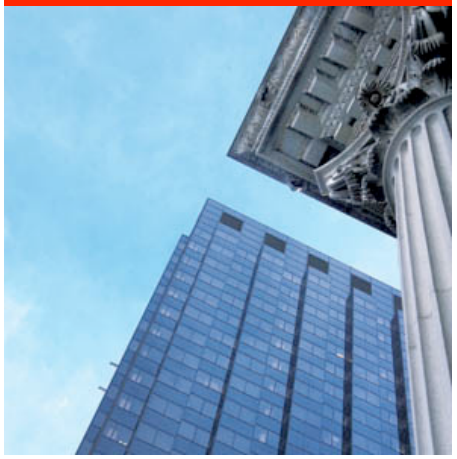
- In previous releases, `DUPLICATE` required RMAN client connections to source and clone databases.
- With enhanced `DUPLICATE`, connection to source database not needed for environments where network connection is not available.



Additional RMAN New Features

Feature	Benefit
Backup Fast Recovery Area to disk location	• Protect Fast Recovery Area with on-disk backup of its RMAN backups, archived logs, and controlfiles.
Extended tablespace point-in-time recovery (TSPITR) capabilities	• Recover a dropped tablespace. • Perform multiple tablespace point-in-time recoveries, without requiring recovery catalog
Resumable `DUPLICATE`	• `DUPLICATE` can resume processing from most points of failure, reducing overall time.
`CONVERT DATABASE` can skip unneeded datafiles	• Reduces overall conversion time by only processing the required UNDO-containing data files.
`SET NEWNAME FOR TABLESPACE | DATABASE`	• Simplifies renaming of datafiles for `RESTORE`, `DUPLICATE`, and `TSPITR` operations.

RMAN Best Practices



RMAN Best Practices

- Fast Recovery Area (FRA) guidelines
  - Place FRA on separate storage & store backups, in addition to copy of control file, redo logs, and archived logs, to protect all needed recovery-related files from production outages.
  - When estimating FRA size, if you want to keep:
    - Control file backups and archived logs
      - Estimate archived logs generated between successive backups on the busiest days and multiply total size by 2 to account for activity spikes.
    - Archived logs and Flashback logs
      - Multiply the archived log size between backups by 4, assuming Flashback retention = time between archived log backups.
    - Incremental backups
      - Add in their estimated sizes
    - On-disk image copy backup
      - Add in size of the database minus the size of temp files

RMAN Performance Factors

Balancing Backup and Restore Requirements

Consideration	Performance Effect
Incremental Backup Strategy	• Incremental backup strategy improves backup performance, with trade-off in recovery performance • Enable block change tracking for fast incremental backups • Cumulative vs. differential incremental backups • 'Incremental forever' requires an initial full then incrementals thereafter – **Fast recovery**: Current image copy of database readily available
Multiplexing	• Backup `'x'` files in parallel per channel, improving backup performance • RMAN multiplexing level = `min(FILESPERSET, MAXOPENFILES)` • Exception: Set `MAXOPENFILES = 1` for SAME or ASM datafiles • Set # of RMAN channels = # of tape drives, so that ***media management multiplexing*** *is not used for RMAN backups* – Setting # of RMAN channels > # of tape drives will impact restore, due to interleaved backup pieces on single tape
Hardware/Network/ Storage	• Assess host resources, production disk I/O, HBA/network, tape drive throughput • Minimum performant component of these will be performance bottleneck

Data Warehouse B&R Best Practices

- Exploit partitioning and read-only tablespaces
  - Older partitions can be moved to read-only tablespaces
  - Backup read-only tablespaces once, then periodically, depending on tape retention policy
- Divide full backup workload across multiple days
- Leverage database & backup compression
- Save time with tablespace level backups
  - Backup index tablespaces less frequently than data tablespaces
  - Backup scarcely used tablespaces less frequently
  - Reduce restore time for most critical tablespaces, by grouping them together in separate backups
- Take incremental backup when NOLOGGING operations finish to ensure recoverability

Test, Test, Test Recovery…

Recovery Scenario	Oracle Technologies
Media Failure	RMAN – restore all files to new storage location
Block Corruption	RMAN Validate, Block Media Recovery, Trial Recovery, LogMiner
User/Logical Error	Flashback Technologies, RMAN TSPITR, LogMiner
Disaster	Data Guard; RMAN -- restore all files to new host/storage

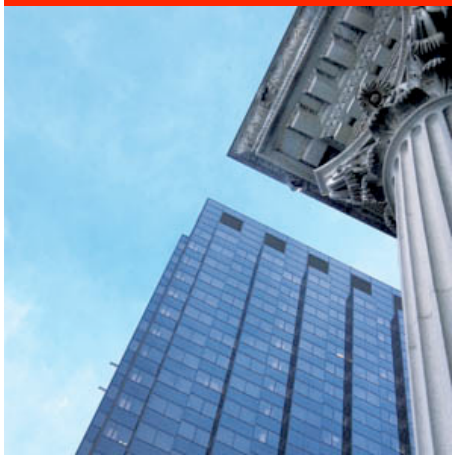
- **Data Recovery Advisor – built-in database failure diagnosis, analysis, & repair tool**

ORACLE DATABASE 11g

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

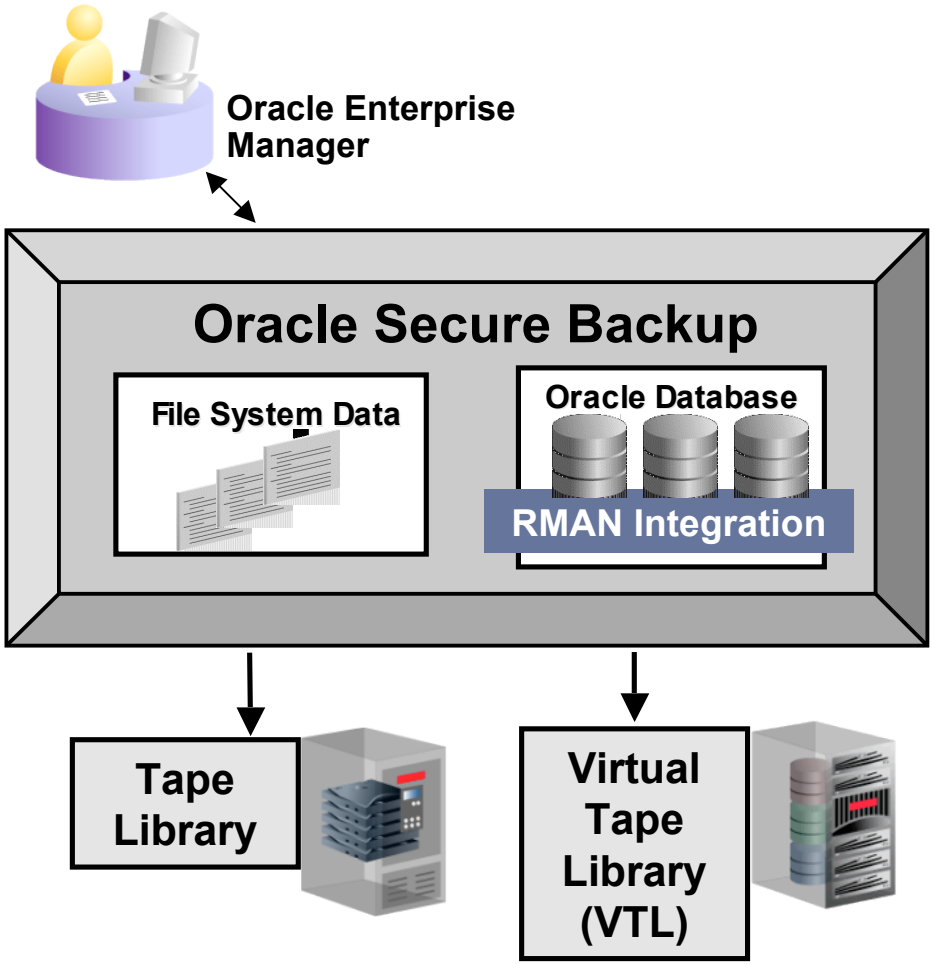
Oracle Secure Backup



Oracle Secure Backup (OSB)

Enterprise Tape Backup Management

ORACLE SECURE BACKUP

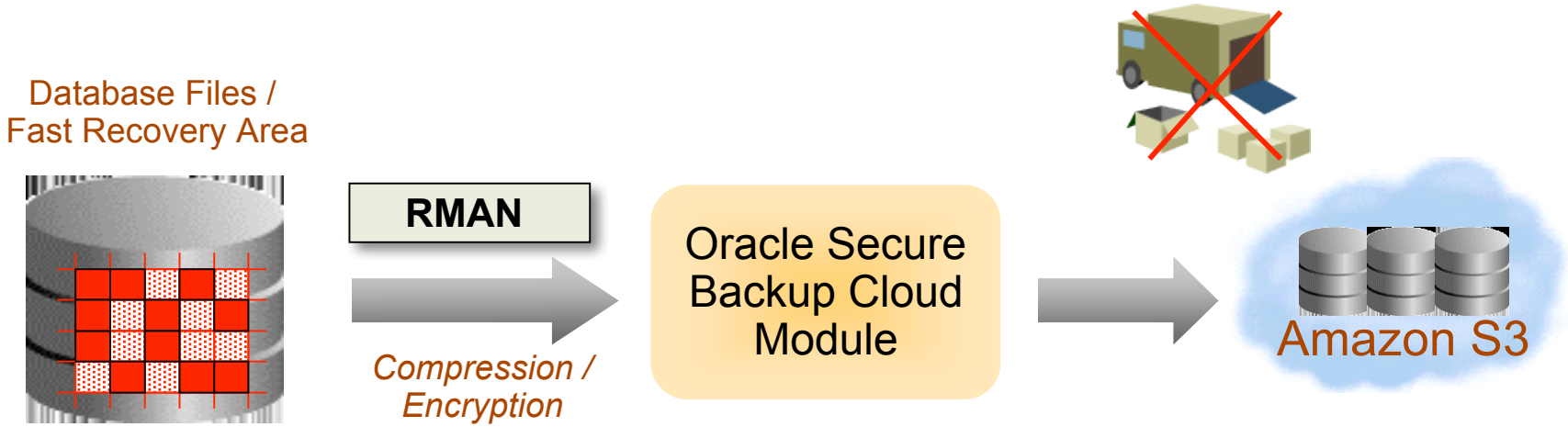


Protects Entire IT Environment

- Oracle Database 11g Release 2 to Oracle9*i*
  - **25 – 40% faster tape backup**
- Heterogeneous file systems (UNIX/ Linux / Windows) and NAS devices
- **Built-in Oracle Integration**
- Centralized management in distributed environments
- **Over 75% less expensive than comparable products**

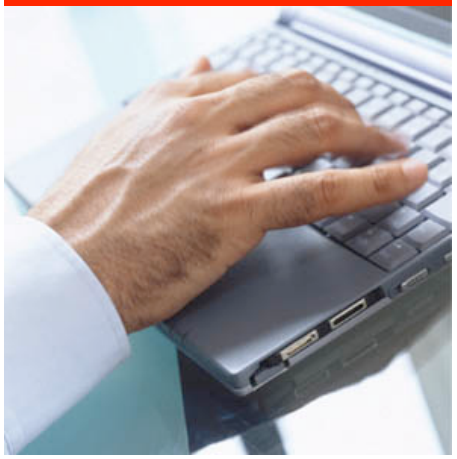
Oracle Secure Backup Cloud Module

Offsite Database Backups in the Cloud



- Oracle Secure Backup Cloud module: Backup databases to Amazon Cloud
  - Complements local disk and/or tape backup
  - Eliminates IT management overhead of a disaster recovery site
  - Backed by Amazon S3 uptime SLAs
- $3,500 per RMAN channel
- More information: http://www.oracle.com/technology/tech/cloud/index.html

Agenda



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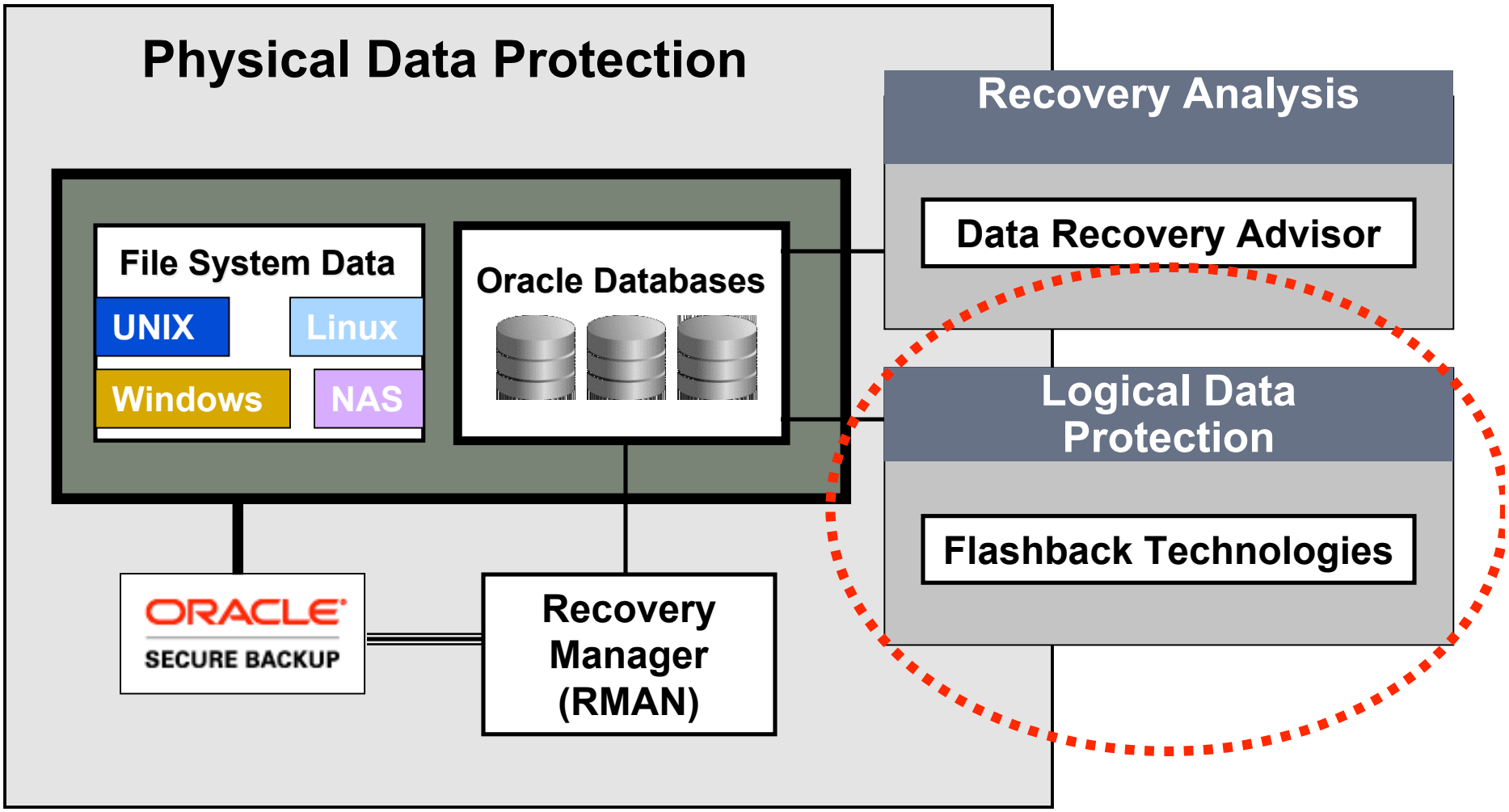
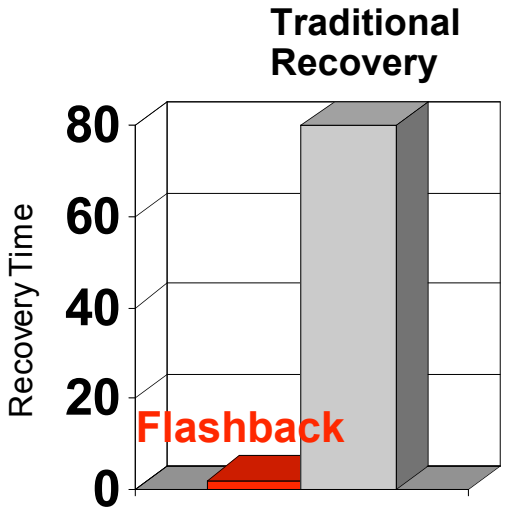
Logical Data Protection

Fast 'Rewind' of Logical Errors



Flashback Technologies

Error Detection & Correction

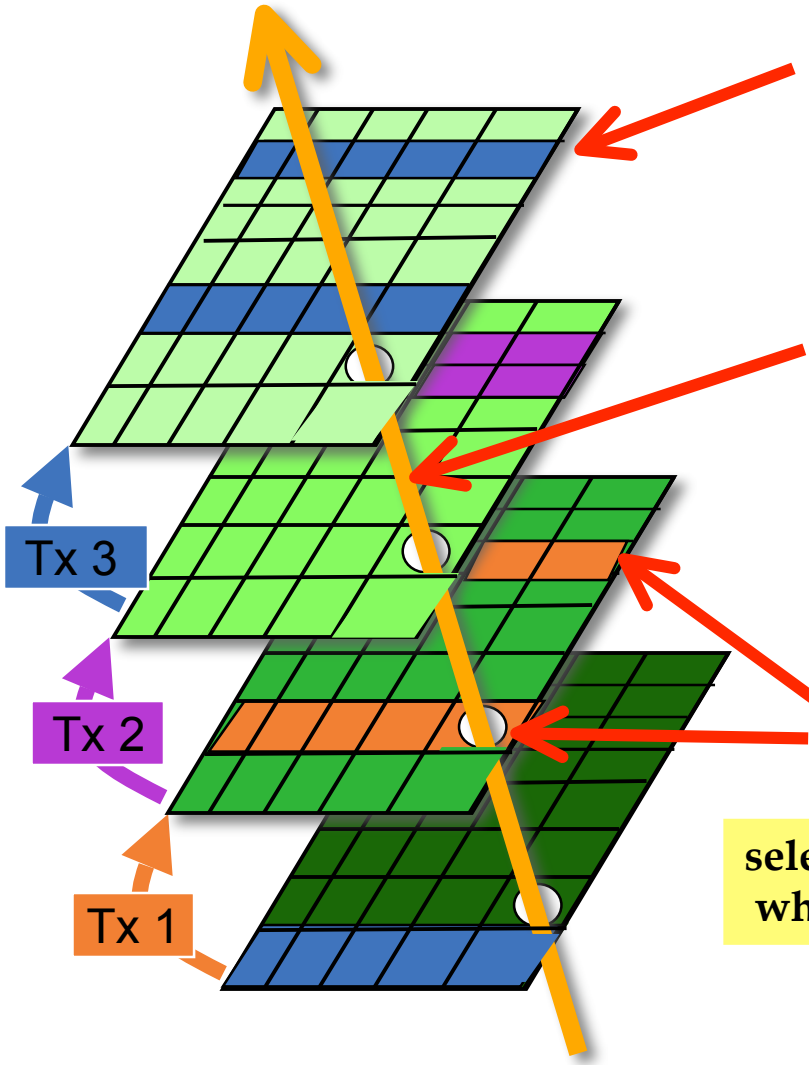


- Flashback revolutionizes error recovery
  - View 'good' data as of a past point-in-time
  - Simply rewind data changes
  - Time to correct error equals time to make error

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 …
```

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

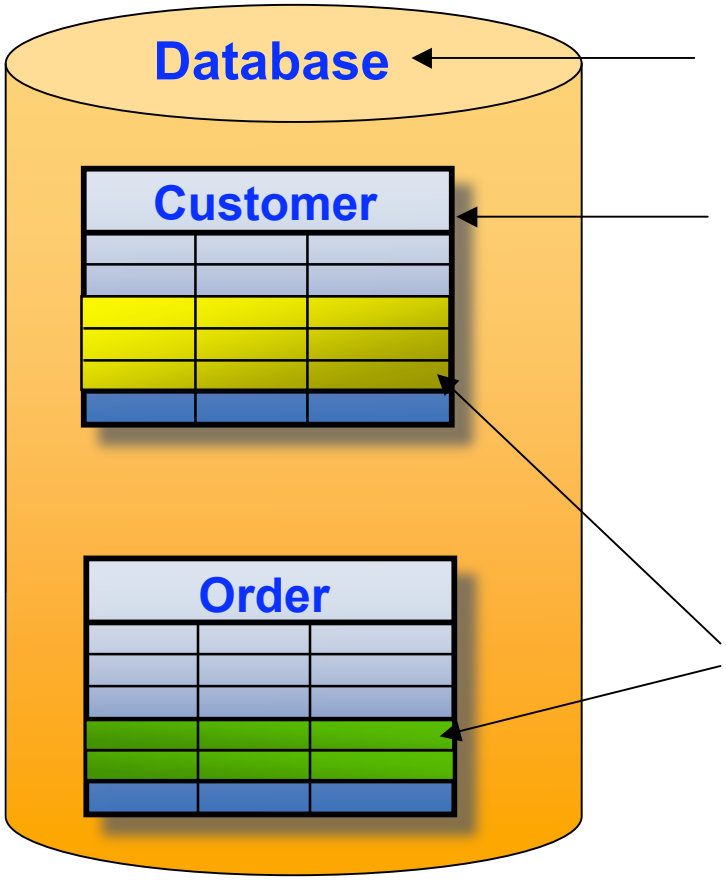
```
select * from Salary VERSIONS BETWEEN
 '12:00 PM' and '2:00 PM' where …
```

Ÿ **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**

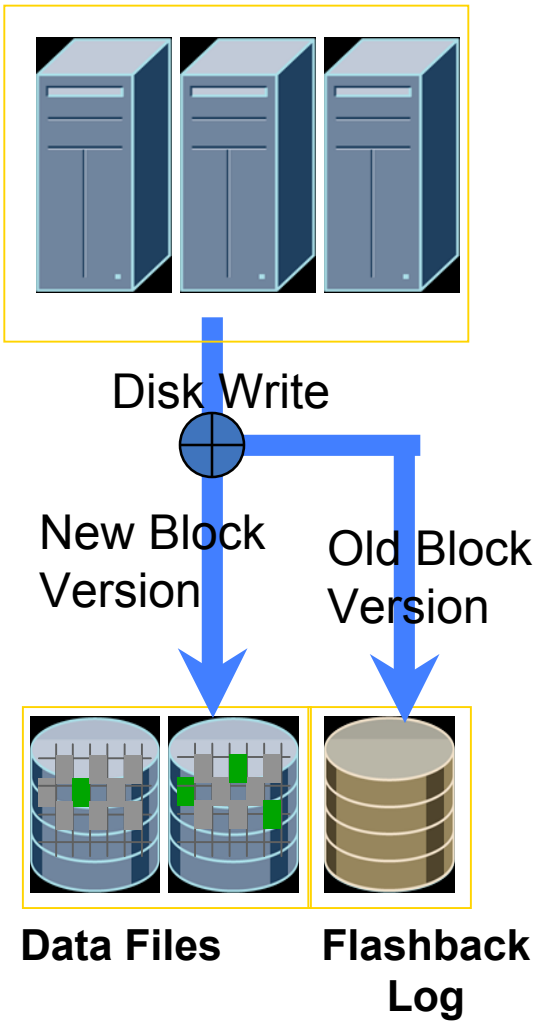
Error Correction with Flashback



- **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)

Flashback Database

Continuous Data Protection (CDP)



- Fast point-in-time recovery strategy
- Eliminate the need to restore a whole database backup
- Continuous data protection for database
  - Optimized, before-change block logging
  - Restores just changed blocks
  - Replay log to restore DB to desired time
- It's fast - recover in minutes, not hours
- It's easy - single command restore

  Flashback Database to '2:05 PM'

"Rewind" button for the Database

Flashback Technologies New Features

Oracle Database 11*g* Release 2

- Increased Availability
  - Enable Flashback Database while database is open
    - Test Flashback without having to take downtime
- Better Manageability
  - Monitor Flashback Database progress with `v$session_longops`
    - Progress percentage can be found with `(SOFAR / TOTALWORK)`
- Minimize System Impact
  - Optimized Flashback logging for batch/insert intensive loads
    - Potentially reduce Flashback logging impact to ~2%
- Extended Dependency Tracking
  - Flashback Transaction supports foreign key dependency tracking

Best Practices – Undo-based Flashback

Flashback Query, Flashback Table

- Use Undo Advisor (available through Enterprise Manager) to get recommendations on available undo retention for various sizes.
- Use fixed size undo
  - Undo retention automatically tuned for best possible retention based on tablespace size and current system load.
- Be aware of DDL restrictions – not possible to query in the past if table structure is modified (e.g. drop/modify column, move table, etc.)
- Further details:
  http://download.oracle.com/docs/cd/B19306_01/appdev.102/b14251/adfns_flashback.htm#sthref1496

Best Practices – Flashback Database

- Tune FRA storage
  - Use ASM, configure enough disk spindles, etc.
- Use physical standby database to test Flashback logging
- Use `V$FLASHBACK_DATABASE_LOG` to size log space, after running
  workload > duration of Flashback retention period.
- Create Guaranteed Restore Point (GRP) without enabling Flashback logging
  - Saves disk space for workloads where same blocks are repeatedly updated
  - Drop GRP to immediately reclaim space
- Further details:
  Metalink Note 565535.1 Flashback Database Best Practices & Performance

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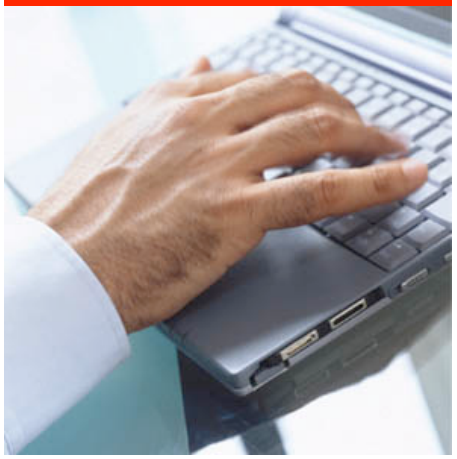

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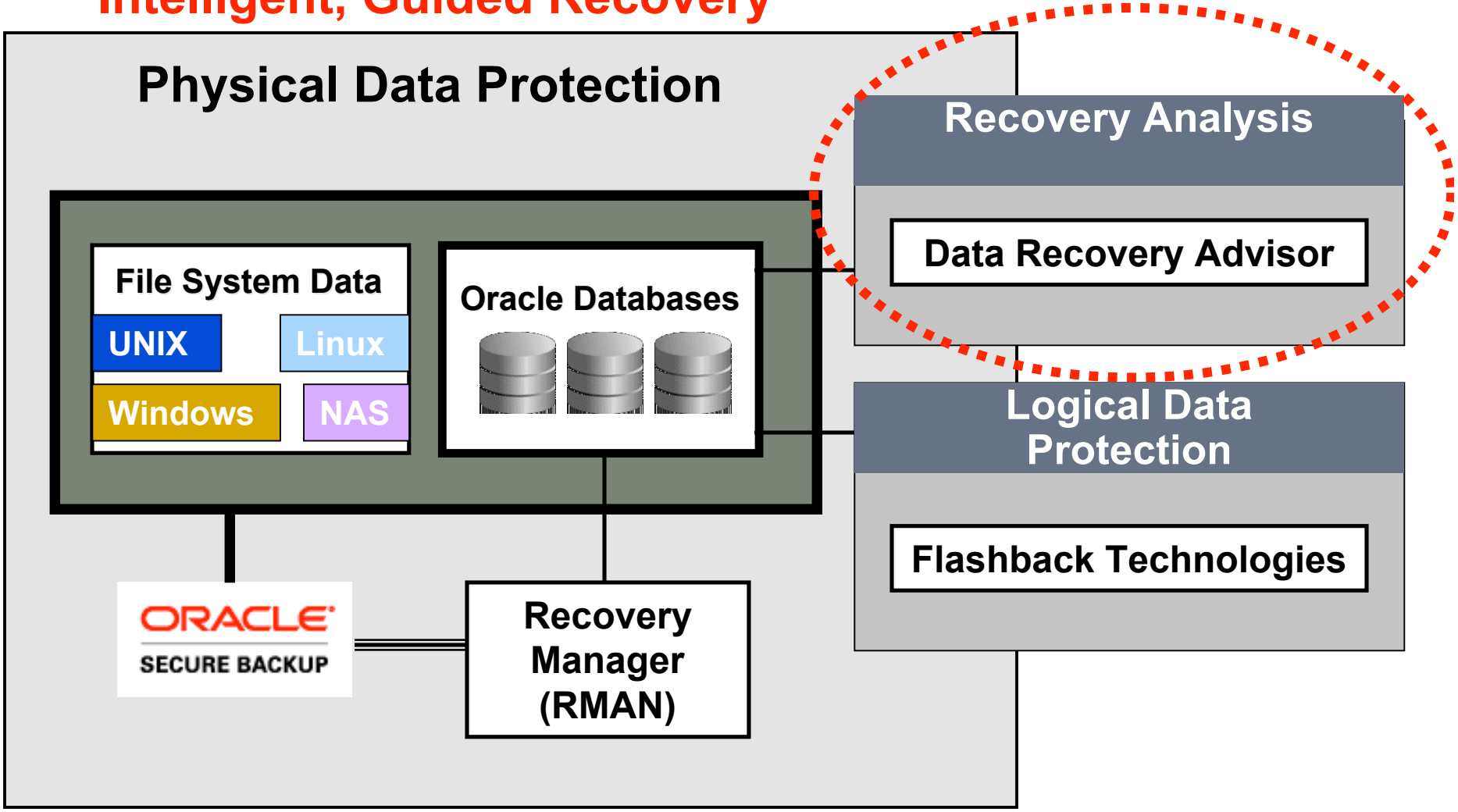
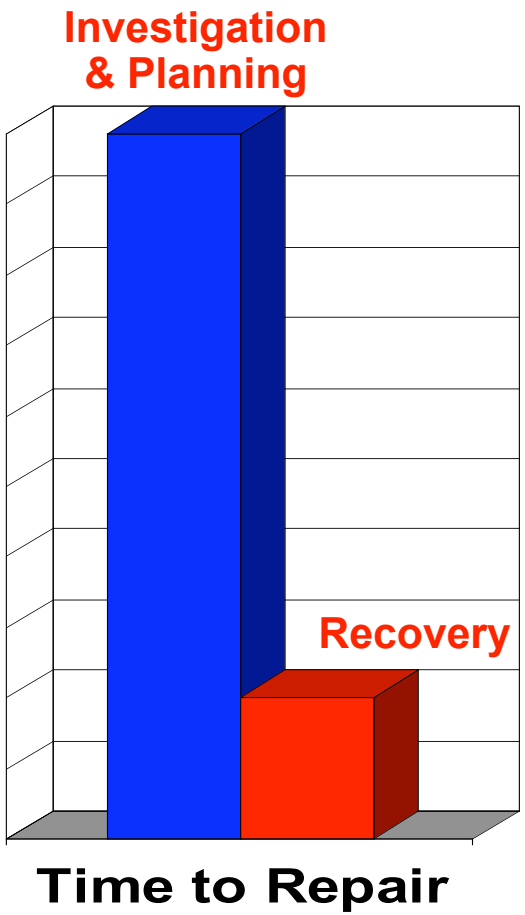
Recovery Analysis

Intelligent, Guided Recovery



Data Recovery Advisor

The Motivation



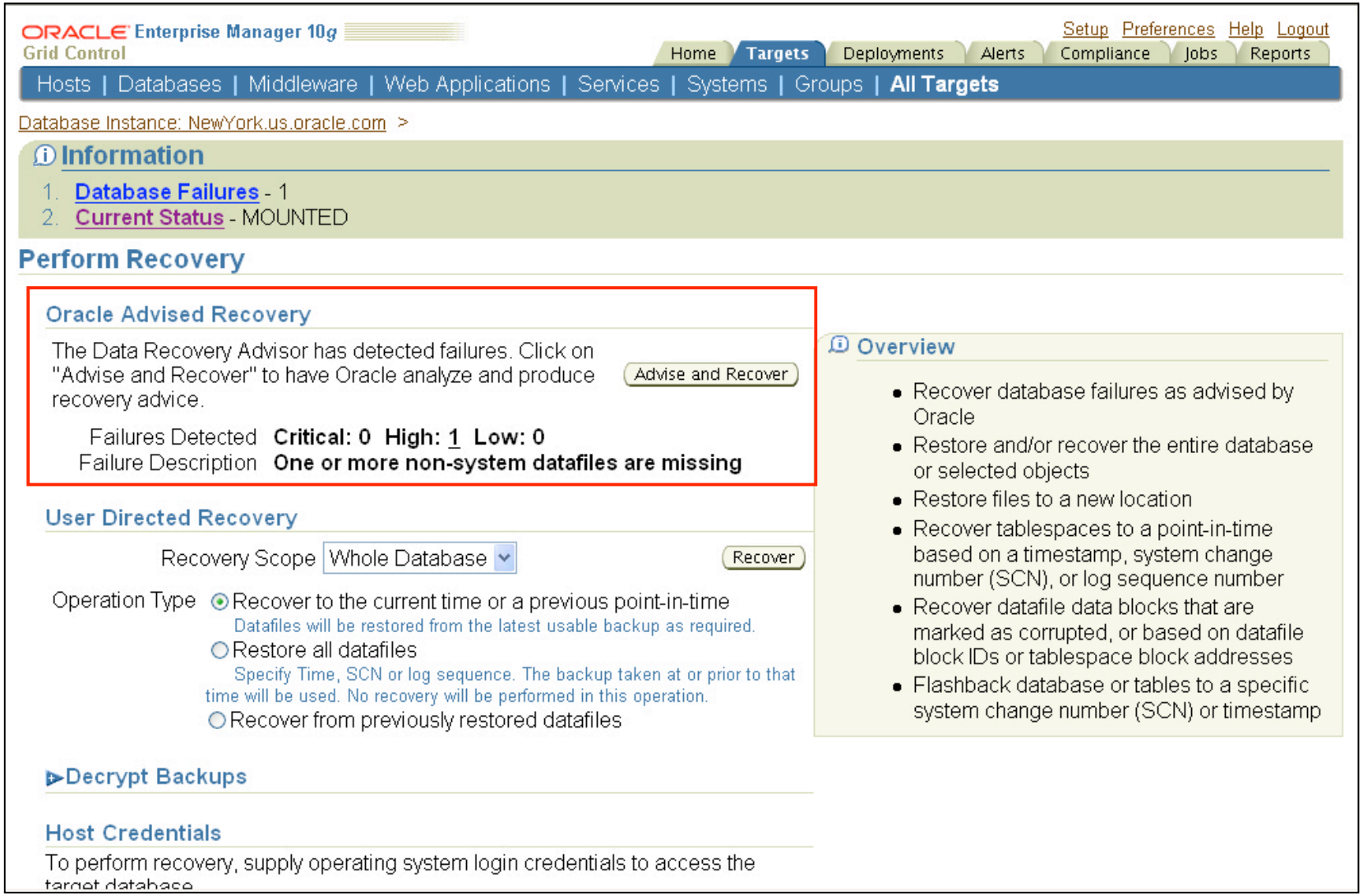
- Oracle provides robust tools for data repair:
  - ✓ RMAN – physical media loss or corruptions
  - ✓ Flashback – logical errors
  - ✓ Data Guard – physical problems
- However, problem diagnosis and choosing the right solution can be error prone and time consuming
  - Errors more likely during emergencies

Data Recovery Advisor (DRA)

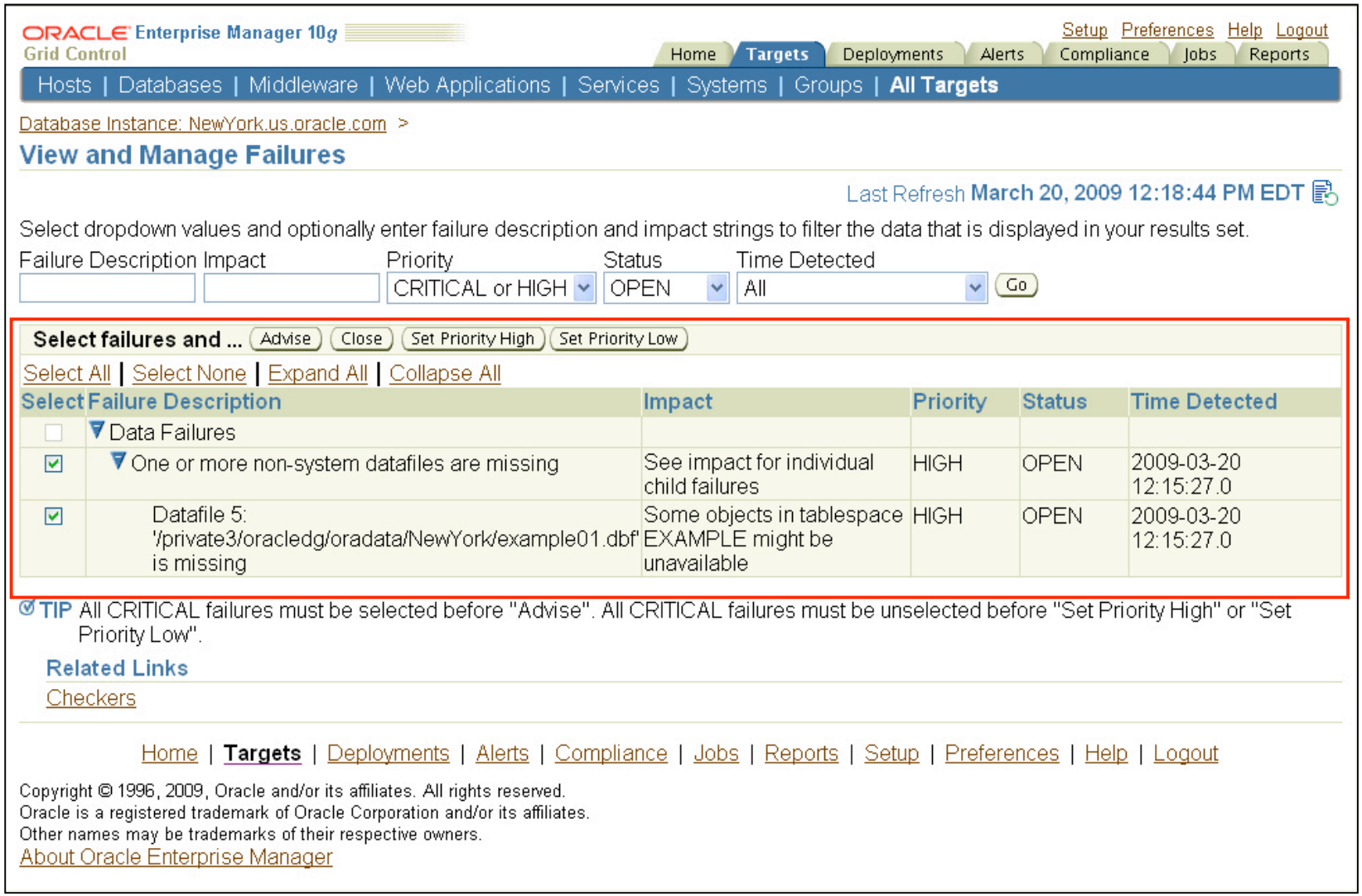
- Oracle Database tool that automatically diagnoses data failures, presents repair options, and executes repairs at the user's request
- Determines failures based on symptoms
  - E.g. an “open failed” because datafiles f045.dbf and f003.dbf are missing
  - Failure Information recorded in diagnostic Automatic 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

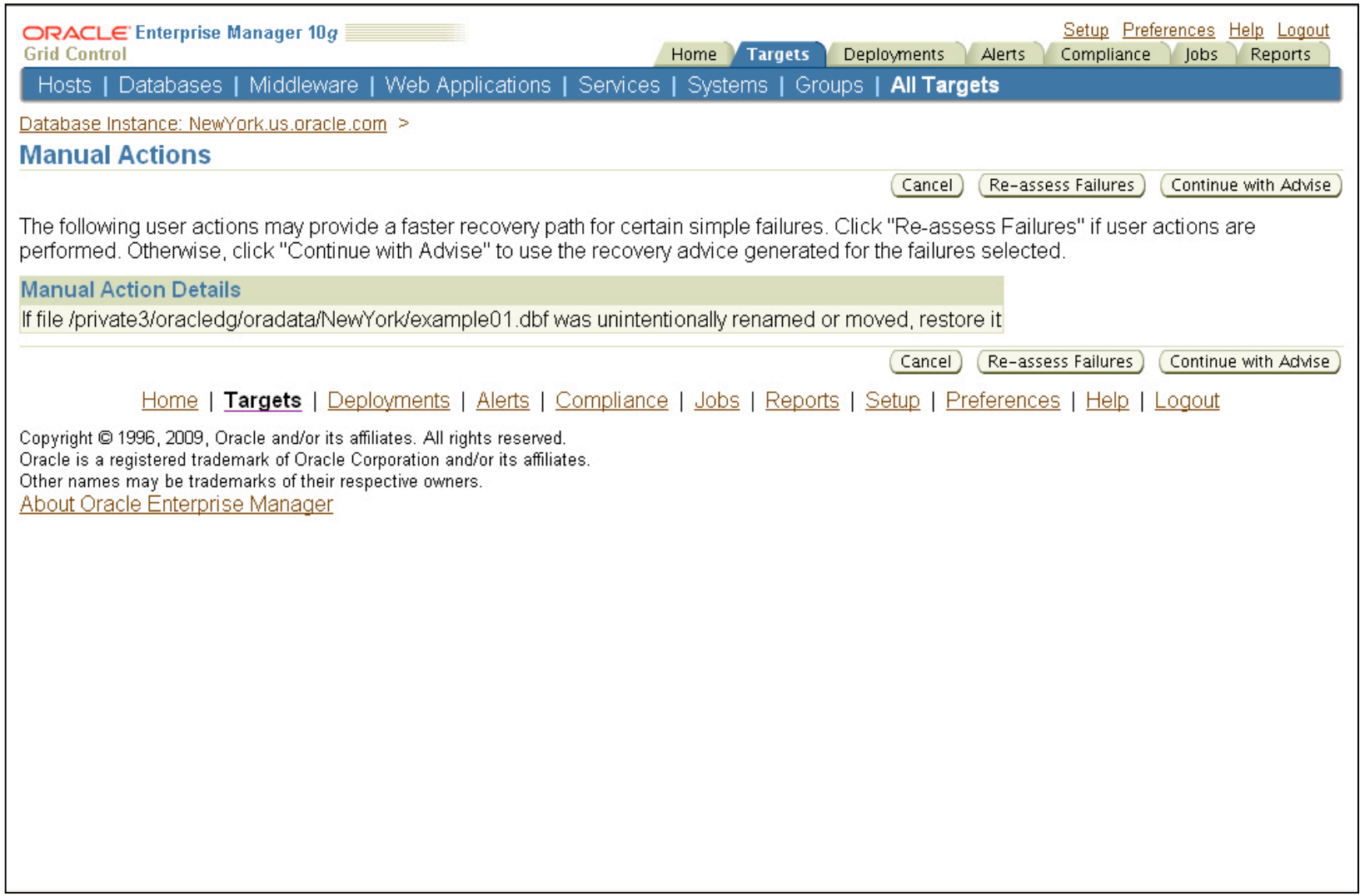
Data Recovery Advisor Wizard



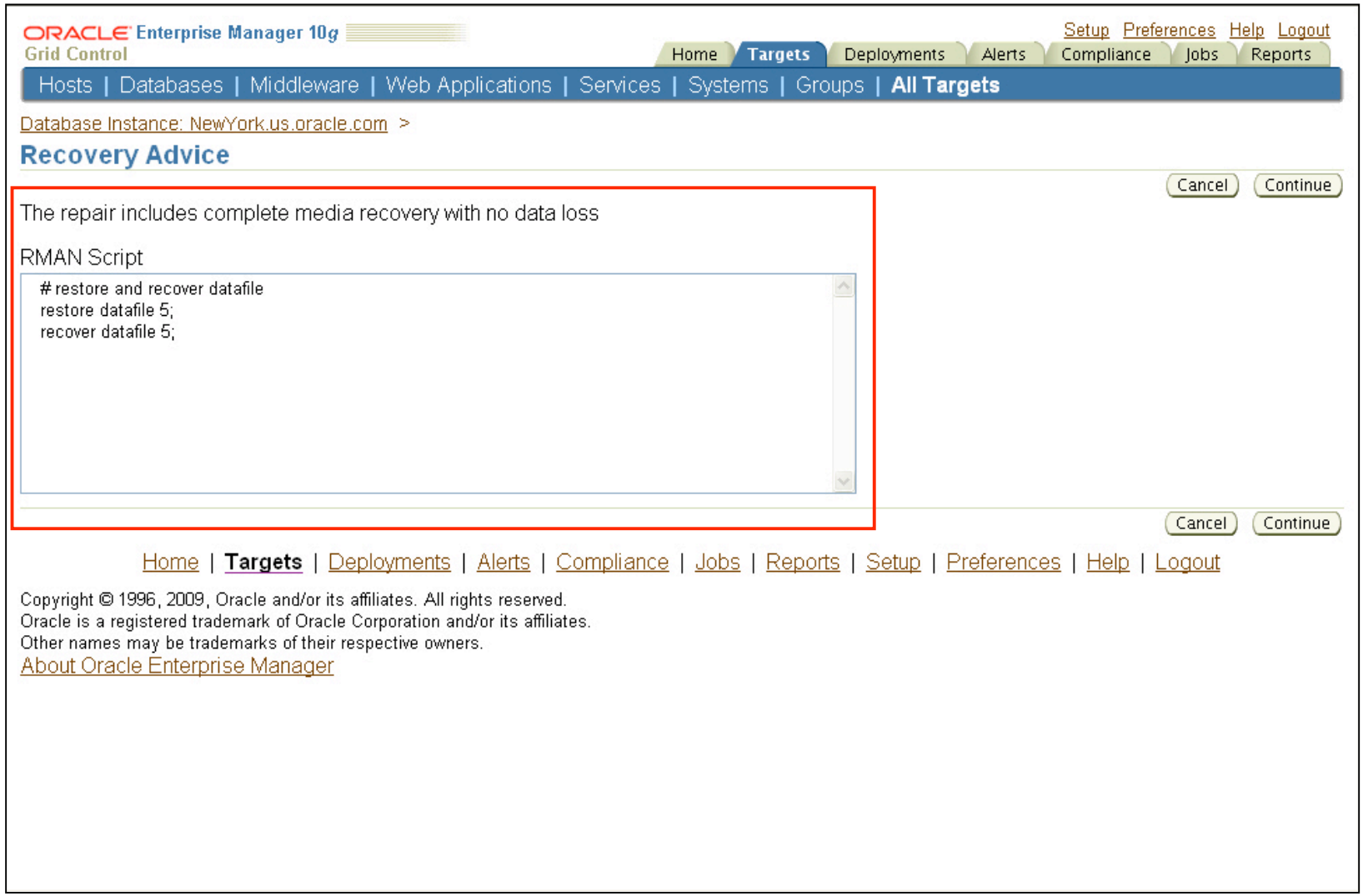
Data Recovery Advisor – View Failures



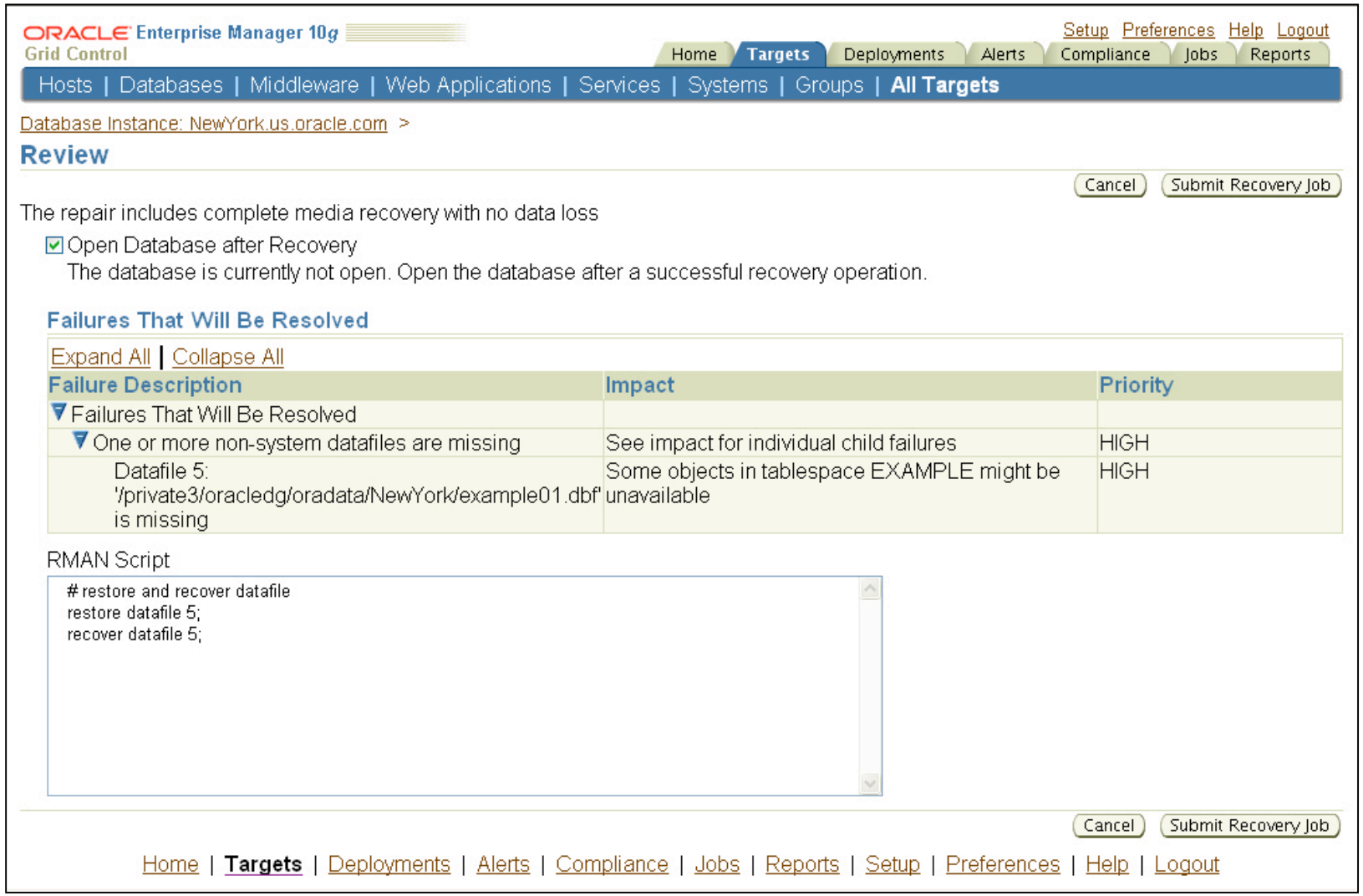
Data Recovery Advisor – Manual Repair



Data Recovery Advisor – Recovery Advice



Data Recovery Advisor – Summary



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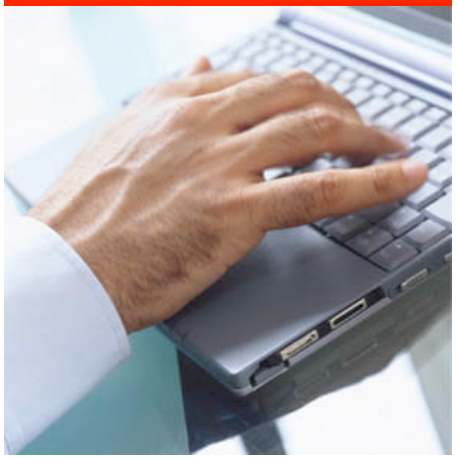

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Putting It All Together..

Customer Example

Requirement	Service Level Agreement	Oracle Solution
RPO	Any point in time within recovery window	➢ Archived Log Mode
RTO **•Tier 3**	• <1 hour for tablespace/datafile recovery <3 hours for full database recovery	➢ RMAN, OSB, DRA
•Tier 2	• <30 min for row/table recovery (within last 3 hrs) <1 hour for database recovery from logical errors (within last 2 hrs)	➢ Flashback Table ➢ Flashback Database
•Tier 1	• <15 min for any database outage	➢ Data Guard
Disaster Recovery	Failover to standby database at secondary site Backups sent offsite	➢ Data Guard ➢ OSB
Retention Policy	Onsite backups - 3 day recovery window Offsite backups - 1 year tape retention	➢ Fast Recovery Area, OSB
Backup Redundancy	Two backup copies on tape	➢ OSB

Recovery SLAs

Customer Example

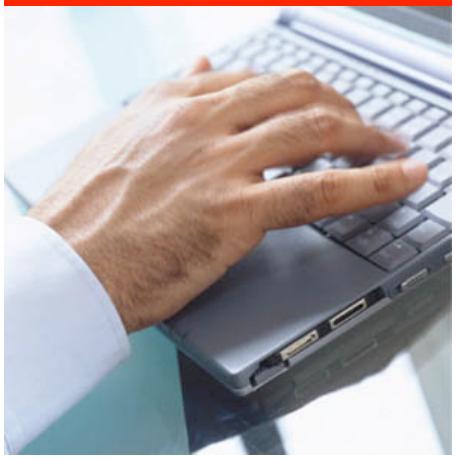
- Oracle Solution - RMAN + OSB + Data Guard + DRA
  - One-time image copy backup to Fast Recovery Area (FRA)
  - Daily differential incremental backup to FRA
  - Image copy rolled forward daily until “sysdate – 4”
  - FRA sized for one image copy backup + 4 incrementals + 4 days of archived logs
  - Daily backup of FRA to tape via OSB (retained for 1 month)
  - Daily vaulting of tape backups to offsite location (retained for 1 year)
  - Real-time, synchronized physical standby database in Maximum Performance mode for disaster recovery
  - Leverage DRA for real-time detection and analysis of failures

Recovery SLAs

Customer Example

- Oracle Solution – Flashback Technologies
  - Size UNDO tablespace for 3 hour retention period
  - Set Flashback Database target retention time to 2 hours
  - Provision Flashback log space in FRA, based on 2 hour workload

Agenda



- What Keeps You Awake at Night?
- Oracle Data Protection Planning & Solutions
- Oracle Backup & Recovery Solutions
  - Physical Data Protection
    - Recovery Manager
    - Oracle Secure Backup
  - Logical Data Protection
    - Flashback Technologies
  - Recovery Analysis
    - Data Recovery Advisor
  - Putting it All Together – Customer Example
- Turkcell Backup & Recovery Case Study
- Q&A

Remember?

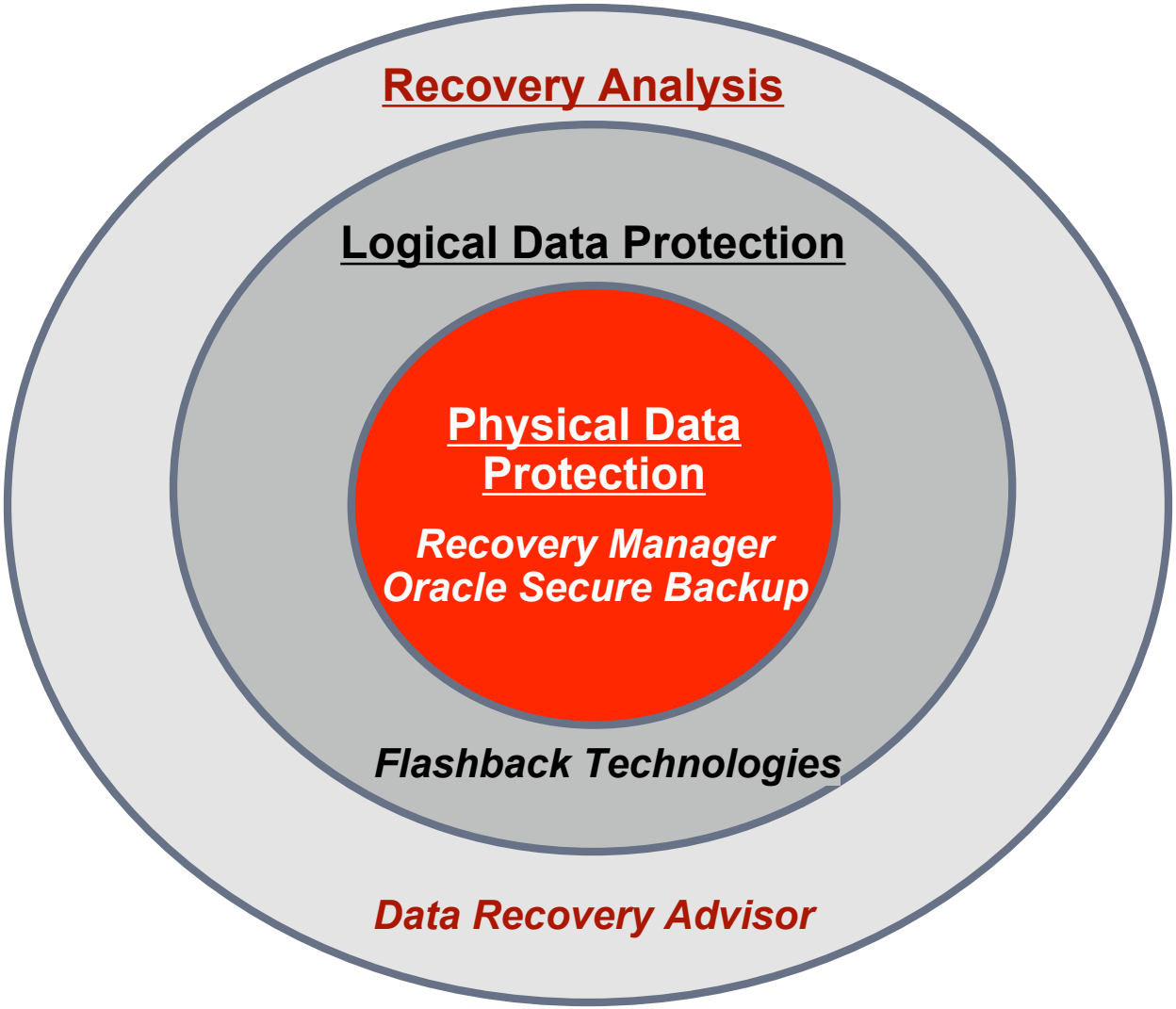
Data Protection Concerns…

- Meeting recovery SLAs?
- Reducing exposure to data loss?
- Meeting backup windows?
- Dealing with long-term backup storage?
- Management complexity?
- Budget?

Solution…

Oracle Backup & Recovery Solutions

Complete & Targeted Recovery



OTN Resources

- Recovery Manager:

  http://www.oracle.com/technology/deploy/availability/htdocs/RMAN_Overview.htm

- Oracle Secure Backup

  http://www.oracle.com/technology/products/secure-backup/index.html

- Flashback Technologies

  http://www.oracle.com/technology/deploy/availability/htdocs/Flashback_Overview.htm

- Oracle Cloud Computing Center

  http://www.oracle.com/technology/tech/cloud/index.html

- Oracle Maximum Availability Architecture

  http://www.oracle.com/technology/deploy/availability/htdocs/maa.htm

HA Sessions, Labs, & Demos by Oracle Development

Sunday, 11 October – Hilton Hotel Imperial Ballroom B

3:45p Online Application Upgrade

Monday, 12 October – Marriott Hotel Golden Gate B1

11:30a Introducing Oracle GoldenGate Products

Monday, 12 October – Moscone South

1:00p Oracle's HA Vision: What's New in 11.2, Room **103**

4:00p Database 11g: Performance Innovations, Room **103**

2:30p Oracle Streams: What's New in 11.2, Room **301**

5:30p Comparing Data Protection Solutions, Room **102**

Tuesday, 13 October – Moscone South

11:30a Oracle Streams: Replication Made Easy, Room **308**

11:30a Backup & Recovery on the Database Machine, Room **307**

11:30a Next-Generation Database Grid Overview, Room **103**

1:00p Oracle Data Guard: What's New in 11.2, Room **104**

2:30p GoldenGate and Streams - The Future, Room **270**

2:30p Backup & Recovery Best Practices, Room **104**

2:30p Single-Instance RAC, Room **300**

4:00p Enterprise Manager HA Best Practices, Room **303**

Hands-on Labs Marriott Hotel Golden Gate B2

Monday 11:30a-2:00p Oracle Active Data Guard, Parts I & II

Thursday 9:00a-11:30a Oracle Active Data Guard, Parts I & II

Tuesday, 13 October – Marriott Hotel Golden Gate B1

11:30a GoldenGate Zero-Downtime Application Upgrades

1:00p GoldenGate Deep Dive: Architecture for Real-Time

Wednesday, 14 October – Moscone South

10:15a Announcing OSB 10.3, Room **300**

11:45a Active Data Guard, Room **103**

5:00p Exadata Storage & Database Machine, Room **104**

Thursday, 15 October – Moscone South

9:00a Empowering Availability for Apps, Room **300**

12:00p Exadata Technical Deep Dive, Room **307**

1:30p Zero-Downtime DB Maintenance, Room **103**

Demos Moscone West DEMOGrounds

Mon & Tue 10:30a - 6:30p; Wed 9:15a - 5:15p

Maximum Availability Architecture (MAA), **W-045**

Oracle Streams: Replication & Advanced Queuing, **W-043**

Oracle Active Data Guard, **W-048**

Oracle Secure Backup, **W-044**

Oracle Recovery Manager & Flashback, **W-046**

Oracle GoldenGate, **3709**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