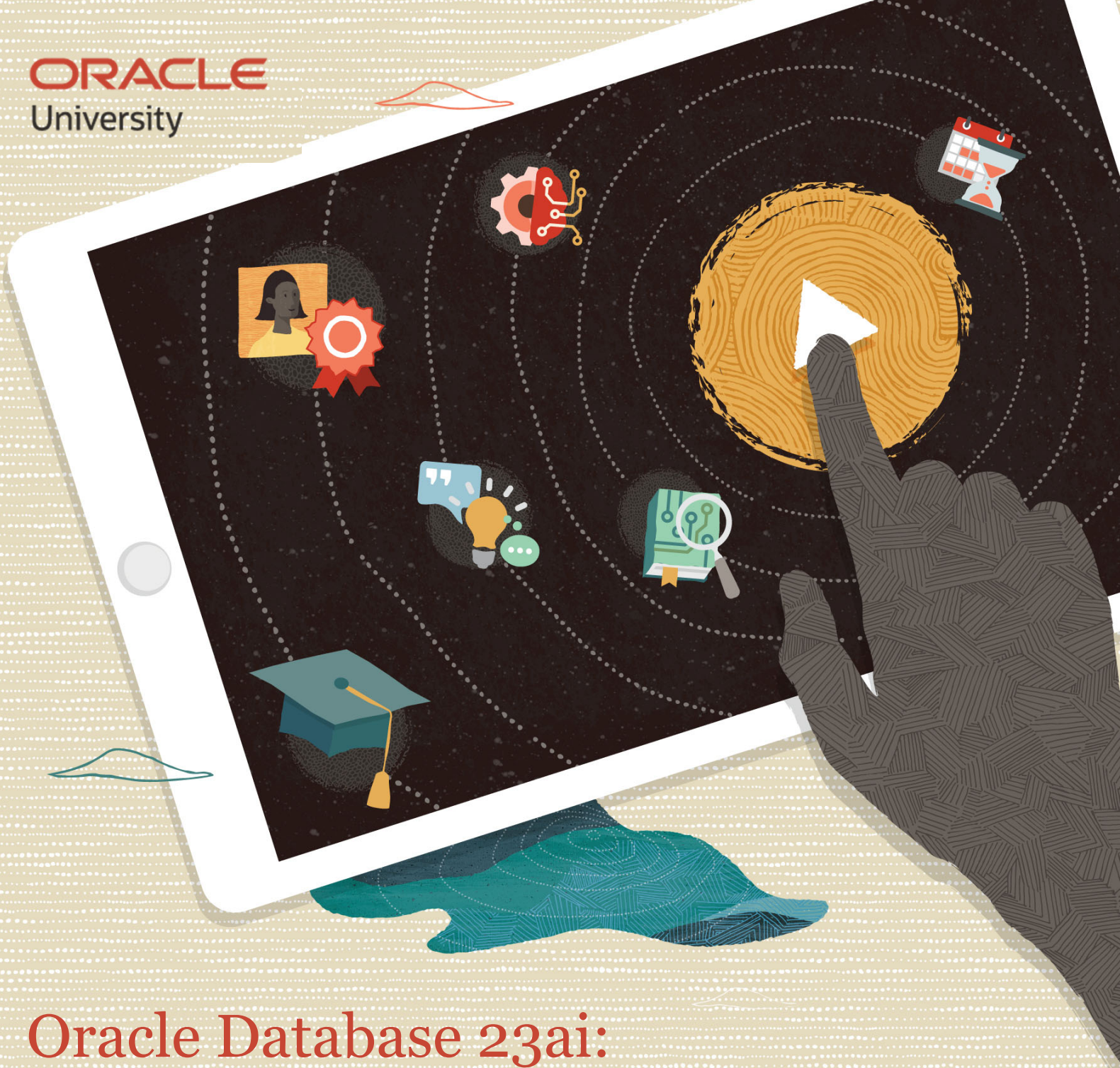




Oracle Database 23ai: Backup and Recovery

Student Guide
D1107714GC10

Copyright © 2024, Oracle and/or its affiliates.

Disclaimer

This document contains proprietary information and is protected by copyright and other intellectual property laws. The document may not be modified or altered in any way. Except where your use constitutes "fair use" under copyright law, you may not use, share, download, upload, copy, print, display, perform, reproduce, publish, license, post, transmit, or distribute this document in whole or in part without the express authorization of Oracle.

The information contained in this document is subject to change without notice and is not warranted to be error-free. If you find any errors, please report them to us in writing.

Restricted Rights Notice

If this documentation is delivered to the United States Government or anyone using the documentation on behalf of the United States Government, the following notice is applicable:

U.S. GOVERNMENT END USERS: Oracle programs (including any operating system, integrated software, any programs embedded, installed or activated on delivered hardware, and modifications of such programs) and Oracle computer documentation or other Oracle data delivered to or accessed by U.S. Government end users are "commercial computer software" or "commercial computer software documentation" pursuant to the applicable Federal Acquisition Regulation and agency-specific supplemental regulations. As such, the use, reproduction, duplication, release, display, disclosure, modification, preparation of derivative works, and/or adaptation of i) Oracle programs (including any operating system, integrated software, any programs embedded, installed or activated on delivered hardware, and modifications of such programs), ii) Oracle computer documentation and/or iii) other Oracle data, is subject to the rights and limitations specified in the license contained in the applicable contract. The terms governing the U.S. Government's use of Oracle cloud services are defined by the applicable contract for such services. No other rights are granted to the U.S. Government.

Trademark Notice

Oracle®, Java, MySQL, and NetSuite are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

Intel and Intel Inside are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. AMD, Epyc, and the AMD logo are trademarks or registered trademarks of Advanced Micro Devices. UNIX is a registered trademark of The Open Group.

Third-Party Content, Products, and Services Disclaimer

This documentation may provide access to or information about content, products, and services from third parties. Oracle Corporation and its affiliates are not responsible for and expressly disclaim all warranties of any kind with respect to third-party content, products, and services unless otherwise set forth in an applicable agreement between you and Oracle. Oracle Corporation and its affiliates will not be responsible for any loss, costs, or damages incurred due to your access to or use of third-party content, products, or services, except as set forth in an applicable agreement between you and Oracle.

1008212024

Contents

1 Course Overview

- Target Audience 1-2
- Prerequisites 1-3
- Learning Outcomes 1-4
- Course Outline 1-6
- What's next? 1-8

2 Backup and Recovery: Overview

- Objectives 2-2
- DBA Responsibilities 2-3
- Separation of DBA Duties 2-4
- Assessing Your Recovery Requirements 2-5
- Categories of Failure 2-7
- Statement Failure 2-8
- User Process Failure 2-9
- Network Failure 2-10
- User Error 2-11
- Instance Failure 2-12
- Media Failure 2-13
- Data Failures 2-14
- Instance Recovery 2-16
- The Checkpoint (CKPT) Process 2-17
- The Redo Log Files and the Log Writer (LGWR) Process 2-18
- Database Log Mode 2-19
- Automatic Instance Recovery or Crash Recovery 2-20
- Phases of Instance Recovery 2-21
- Tuning Instance Recovery 2-22
- Using the MTTR Advisor 2-24
- Restoring and Recovering 2-25
- Comparing Complete and Incomplete Recovery 2-26
- The Complete Recovery Process 2-27
- The Point-in-Time Recovery Process 2-28
- Oracle Data Protection Solutions 2-30
- Flashback Technology 2-31
- Summary 2-32

3 Backup and Recovery Configuration

- Objectives 3-2
- Configuring for Recoverability 3-3
- Configuring the Fast Recovery Area 3-4
- Monitoring the Fast Recovery Area 3-6
- Multiplexing controlfiles 3-7
- Redo Log Files 3-8
- Multiplexing the Redo Log 3-9
- Creating Archived Redo Log Files 3-10
- Archiver (ARCn) Process 3-11
- Archived Redo Log Files: Naming and Destinations 3-12
- Configuring ARCHIVELOG Mode 3-13
- Summary 3-14

4 Using Recovery Manager (RMAN)

- Objectives 4-2
- Integrated Oracle Recovery Manager (RMAN) 4-3
- Connecting to RMAN and a Target Database 4-4
- Using SQL in RMAN 4-5
- Types of RMAN Commands 4-6
- Job Commands: Example 4-7
- Configuring Persistent Settings for RMAN 4-8
- Viewing Persistent Settings 4-10
- Managing Persistent Settings 4-11
- Specifying a Retention Policy 4-12
- Recovery Window Retention Policy: Example 4-14
- Summary 4-19

5 Backup Strategies

- Objectives 5-2
- Understanding Types of Backups 5-3
- Backup Terminology 5-4
- Understanding Types of Backups 5-5
- RMAN Backup Types 5-6
- Backup Solutions: Overview 5-8
- Balancing Backup and Restore Requirements 5-9
- Comparing Backup Strategies 5-11
- Option 1: Full and Incremental Backups 5-12
- Option 2: Incrementally Updated Disk Backups 5-13

Option 3: Offloading Backups Physical Standby Database in Data Guard Environment 5-14
Backing Up Read-Only Tablespaces: Considerations 5-15
Data Warehouse Backup and Recovery: Best Practices 5-16
Summary 5-18

6 Creating Database Backups

Objectives 6-2
Using RMAN Commands to Create Backups 6-3
Syntax and Clauses in RMAN 6-4
Creating Backup Sets 6-5
Creating Image Copies 6-6
Creating a Whole Database Backup 6-7
CDB Backup: Whole CDB Backup 6-8
CDB Backup: Partial CDB Backup 6-9
PDB Backup: Partial PDB Backup 6-10
Review: RMAN Backup Types 6-11
Incrementally Updated Backups 6-13
Incrementally Updated Backups: Example 6-14
Fast Incremental Backup 6-15
Maintaining the Block Change Tracking File 6-16
Monitoring Block Change Tracking 6-17
Automatic Disk-to-Disk Backup and Recovery 6-18
Oracle-Suggested Backup 6-19
Backing Up the controlfile to a Trace File 6-20
Cataloging Additional Backup Files 6-21
Reporting on Backups 6-23
Using Dynamic Views 6-24
Summary 6-25

7 Using Optional Backup Features

Objectives 7-2
Saving Backup Space with Unused Block Compression 7-3
Compressing Backups 7-4
Using RMAN Backup Compression 7-5
Using a Media Manager 7-6
Configuring Backup and Restore for Very Large Files 7-8
Backing Up and Restoring Very Large Files 7-9
Creating RMAN Multisection Backups 7-10
Creating Proxy Copies 7-11
Creating Duplexed Backup Sets Using BACKUP COPIES 7-12

- Creating Backups of Backup Sets 7-13
- Archival Backups: Concepts 7-14
- Creating Archival Backups with RMAN 7-16
- Managing Archival Database Backups 7-17
- Backing Up Recovery Files 7-18
- Summary 7-19

8 Tuning RMAN Backup Performance

- Objectives 8-2
- Is there a problem? 8-3
- Diagnosing Performance Bottlenecks 8-4
- Diagnosing Performance Bottlenecks: Read Phase 8-5
- Is there a “write” problem? 8-6
- Diagnosing Performance Bottlenecks: Write or Copy Phase 8-7
- Using Dynamic Views to Diagnose RMAN Performance 8-9
- Monitoring RMAN Job Progress 8-10
- Identifying Backup and Restore Bottlenecks 8-12
- Asynchronous I/O Bottlenecks 8-13
- Synchronous I/O Bottlenecks 8-14
- Tuning RMAN Backup Performance 8-15
- Parallelization of Backup Sets 8-16
- RMAN Multiplexing 8-18
- Summary 8-20

9 Recovery Catalog Overview

- Objectives 9-2
- RMAN Repository Data Storage: Comparison of Options 9-3
- Storing Information in the Recovery Catalog 9-4
- Reasons to Use a Recovery Catalog 9-5
- Summary 9-6

10 Creating a Recovery Catalog

- Objectives 10-2
- Creating a Recovery Catalog: Three Steps 10-3
- 1. Configuring the Recovery Catalog Database 10-4
- 2. Creating the Recovery Catalog Owner 10-5
- 3. Creating the Recovery Catalog 10-6
- Summary 10-7

11 Managing Target Database Records

Objectives 11-2

Managing Target Database Records in the Recovery Catalog 11-3

Registering a Database in the Recovery Catalog 11-4

Unregistering a Target Database from the Recovery Catalog 11-6

Recovery Catalog Resynchronization: Concepts 11-7

Manually Resynchronizing the Recovery Catalog 11-9

Summary 11-10

12 Using Stored Scripts

Objectives 12-2

Using RMAN Stored Scripts 12-3

Executing RMAN Stored Scripts 12-4

Maintaining RMAN Stored Scripts 12-5

Summary 12-7

13 Creating and Using Virtual Private Catalogs

Objectives 13-2

Creating and Using Virtual Private Catalogs 13-3

Creating a Virtual Private Catalog 13-4

Managing Virtual Private Catalogs 13-6

Upgrading Catalog 13-7

Upgrading Virtual Private Catalogs 13-8

Upgrading Catalog Example 13-9

Upgrading Catalog 13-10

Summary 13-11

14 Restore and Recovery Concepts

Objectives 14-2

File Loss 14-3

Data Repair Techniques 14-4

Restoring and Recovering 14-5

Using RMAN RESTORE and RECOVER Commands 14-6

Instance Failure 14-7

Instance Recovery 14-8

Phases of Instance Recovery 14-9

Media Failure 14-10

Comparing Complete and Incomplete Recovery 14-11

Complete Recovery Process 14-12

Point-in-Time Recovery Process 14-13

Recovery with the RESETLOGS Option 14-15

Restore and Recovery Performance: Best Practices 14-16
Summary 14-17

15 Diagnosing Failures

Objectives 15-2
Reducing Problem Diagnosis Time 15-3
Automatic Diagnostic Workflow 15-4
Automatic Diagnostic Repository 15-5
ADR Command-Line Tool (ADRCI) 15-6
V\$DIAG_INFO View 15-7
Data Failure: Examples 15-8
Summary 15-9

16 Performing Complete Recovery

Objectives 16-2
Ensuring Backups Are Available 16-3
Restoring in NOARCHIVELOG Mode 16-4
Recovery with Incremental Backups in NOARCHIVELOG Mode 16-6
Performing Complete Recovery 16-7
Review: Recovering Image Copies 16-9
Recovering Image Copies: Example 16-10
Performing a Fast Switch to Image Copies 16-11
Using SET NEWNAME for Switching Files 16-12
Using Restore Points 16-13
PDB Temp File Recovery 16-14
PDB SYSTEM or UNDO Tablespace Recovery 16-15
PDB Non-SYSTEM Tablespace Recovery 16-16
Summary 16-17

17 Performing Point-in-Time Recovery

Objectives 17-2
Point-in-Time Recovery 17-3
PITR Terminology 17-4
Performing Point-in-Time Recovery 17-5
When to Use TSPITR 17-7
Tablespace Point-in-Time Recovery: Architecture 17-8
Preparing for TSPITR 17-10
Determining the Correct Target Time 17-11
Determining the Tablespaces for the Recovery Set 17-12
Identifying Objects That Will Be Lost 17-13
Performing RMAN TSPITR 17-14

- Performing Fully Automated TSPITR 17-15
- Improving TSPITR Performance 17-16
- Performing RMAN TSPITR with an RMAN-Managed Auxiliary Instance 17-18
- Performing RMAN TSPITR Using Your Own Auxiliary Instance 17-20
- Troubleshooting RMAN TSPITR 17-21
- PITR of PDBs 17-22
- Recovering Tables from Backups 17-23
- Table Recovery: Graphical Overview 17-24
- Prerequisites and Limitations 17-25
- Specifying the Recovery Point in Time 17-26
- Process Steps of Table Recovery 17-28
- Summary 17-31

18 Performing Block Media Recovery

- Objectives 18-2
- What is block corruption? 18-3
- Block Corruption Symptoms: ORA-01578 18-4
- How to Handle Corruption 18-5
- Setting Parameters to Detect Corruption 18-6
- Block Media Recovery 18-8
- Prerequisites for Block Media Recovery 18-10
- Recovering Individual Blocks 18-11
- Best Practice: Proactive Checks 18-12
- Checking for Block Corruption 18-13
- Summary 18-15

19 Performing Additional Recovery Operations

- Objectives 19-2
- Recovery from the Loss of the Server Parameter File 19-3
- Restoring the Server Parameter File from the controlfile Autobackup 19-4
- Loss of a controlfile 19-5
- Recovering from the Loss of All controlfile Copies: Overview 19-6
- Restoring the controlfile from Autobackup 19-7
- Restoring the SPFILE and the controlfile 19-8
- Recovering NOLOGGING Database Objects 19-9
- Loss of a Redo Log File 19-10
- Log Group Status: Review 19-12
- Recovering from the Loss of a Redo Log Group 19-13
- Clearing a Log File 19-14
- Re-creating a Password Authentication File 19-15
- Summary 19-17

20 Oracle Flashback Technology: Overview

- Objectives 20-2
- Configuring Database Flashback Technologies 20-3
- Flashback Technologies: Error Detection and Correction 20-10
- Review: Transactions and Undo 20-11
- Flashback Technology 20-12
- Summary 20-14

21 Using Logical Flashback Features

- Objectives 21-2
- Using Flashback Technologies to Query Data 21-3
- Flashback Query 21-4
- Flashback Version Query 21-5
- Flashback Table: Overview 21-6
- Flashback Table 21-7
- Flashback Table: Considerations 21-8
- Flashback Transaction Query 21-9
- Flashback Transaction Query: Considerations 21-10
- Flashback Transaction Backout 21-11
- Flashback Transaction Backout Options 21-12
- Flashing Back a Transaction 21-13
- Best Practices: Undo-Based Flashback Query, Flashback Table 21-14
- Flashback Drop and the Recycle Bin 21-15
- Recycle Bin 21-16
- Bypassing the Recycle Bin 21-17
- Using Flashback Time Travel 21-18
- Creating and Enabling Flashback Time Travel 21-19
- How the Flashback Data Archive Works 21-21
- Transparent Schema Evolution 21-22
- Full Schema Evolution 21-23
- Summary 21-24

22 Using Flashback Database

- Objectives 22-2
- Preparing Your Database for Flashback 22-3
- Guaranteeing Undo Retention 22-4
- Undo Retention 22-6
- Flashback Database: Continuous Data Protection 22-7
- Flashback Database 22-8
- Flashback Database Architecture 22-9
- Configuring Flashback Database 22-10

- Configuring Flashback Database Overview 22-11
- Configuring Flashback Database Parameters 22-12
- Configuring Flashback Database Log Management 22-15
- Flashback Database: Examples 22-16
- CDB and PDB Flashback 22-17
- Flashback Database Considerations 22-18
- Monitoring Flashback Database Information 22-19
- Flashback Database and Guaranteed Restore Points 22-21
- Guaranteed Restore Points 22-22
- PDB Flashback and Clean Restore Point 22-23
- Summary 22-24

23 Transport Using Recovery Catalog

- Objectives 23-2
- Overview 23-3
- Methods of Transporting with Recovery Catalog 23-6
- Prerequisites: Generic 23-7
- Prerequisites: Specific 23-8
- Recovery Catalog Methods for PDBs 23-9
- Quickly Transport a PDB with Recovery Catalog 23-12
- Transport a PDB Using a Preexisting Backup with Recovery Catalog 23-18
- Transport a PDB Using Multiple Incremental Backups with Recovery Catalog 23-23
- Recovery Catalog Methods for Tablespaces 23-25
- Quickly Transport a Tablespace with Recovery Catalog 23-27
- Transport a Tablespace Using a Preexisting Backup with Recovery Catalog 23-32
- Transport a Tablespace Using Multiple Incremental Backups with Recovery Catalog 23-37
- Transport a PDB Using Multiple Incremental Backups with Recovery Catalog 23-44
- Summary 23-46

24 Transport Using NOCATALOG

- Objectives 24-2
- Methods of Transporting in NOCATALOG Mode 24-3
- Prerequisites: Generic 24-4
- Prerequisites: Specific 24-5
- NOCATALOG Mode for PDBs 24-6
- Quickly Transport a PDB in NOCATALOG Mode 24-8
- Transport a PDB Using a Preexisting Backup in NOCATALOG Mode 24-13
- Transport a PDB Using Multiple Incremental Backups in NOCATALOG Mode 24-18
- NOCATALOG Mode for Tablespaces 24-28
- Quickly Transport a Tablespace in NOCATALOG Mode 24-29

Transport a Tablespace Using a Preexisting Backup in NOCATALOG Mode 24-34
Transport a Tablespace Using Multiple Incremental Backups in
NOCATALOG Mode 24-39
Summary 24-49

25 Transport Using Network Link

Objectives 25-2
Methods of Transporting Over Network Link 25-3
Prerequisites: Generic 25-4
Methods of Transporting PDBs Over Network Link 25-5
Transporting PDBs Over Network Link 25-6
Quickly Transport a PDB Over Network Link 25-7
Transport PDBs by Restoring Backups Incrementally Over the Network 25-11
Methods of Transporting Tablespaces Over Network Link 25-19
Transport Tablespaces Over Network Link 25-20
Quickly Transport a Tablespace Over Network Link 25-21
Transport Tablespaces by Restoring Backups Incrementally Over
the Network 25-25
Summary 25-33

26 Using PDB Snapshots

Objectives 26-2
PDB Snapshot Carousel 26-3
Creating PDB Snapshots 26-4
Creating PDBs Using PDB Snapshots 26-5
PDB Snapshots Basics 26-6
PDB Snapshots Views 26-7
Dropping PDB Snapshots 26-9
Flashing Back PDBs Using PDB Snapshots 26-11
Summary 26-12

27 Database Duplication Overview

Objectives 27-2
Using a Duplicate Database 27-3
Choosing Database Duplication Techniques 27-4
Duplicating an Active Database with “Push” 27-5
Comparing the “Push” and “Pull” Methods of Duplication 27-6
Duplicating a Database with a Target Connection 27-7
Duplicating a Database with a Recovery Catalog 27-8
Duplicating a Database Without a Recovery Catalog or Target Connection 27-9
Summary 27-10

28 Creating a Backup-Based Duplicate Database

Objectives	28-2
Creating a Backup-Based Duplicate Database	28-3
Creating an Initialization Parameter File for the Auxiliary Instance	28-4
Specifying New Names for Your Destination	28-5
Using the SET NEWNAME Clauses	28-6
Substitution Variables for SET NEWNAME	28-7
Specifying Parameters for File Naming	28-8
Starting the Instance in NOMOUNT Mode	28-9
Ensuring Backups and Archived Redo Log Files Are Available	28-10
Allocating Auxiliary Channels	28-11
Understanding the RMAN Duplication Operation	28-12
Specifying Options for the DUPLICATE Command	28-14
Using Additional DUPLICATE Command Options	28-15
Duplicating Selected PDBs in a CDB	28-16
Cloning an Active PDB into an Existing CDB	28-17
Example: Duplicating PDB1 from CDB1 to CDB2 as PDB1	28-18
Example: Duplicating PDB1 from CDB1 to CDB2 as PDB2	28-19
Summary	28-20

