

Oracle Database 11g: RAC Administration

Student Guide

D50311GC40

Edition 4.0

December 2012

D78200

ORACLE®

Authors

James Womack

James Spiller

Technical Contributors and Reviewers

Christopher Andrews

Christian Bauwens

Harald Van Breederode

David Brower

Michael Cebulla

Jonathan Creighton

Al Flournoy

Andy Fortunak

Mark Fuller

Joel Goodman

Michael Hazel

Pete Jones

Mike Leatherman

Jerry Lee

Barb Lundhild

Markus Michalewicz

Peter Sharman

Ranbir Singh

Linda Smalley

Janet Stern

Richard Strohm

S. Matt Taylor

Branislav Valny

Jean-Francois Verrier

Rick Wessman

Doug Williams

Editors

Aju Kumar

Smita Kommini

Daniel Milne

Publishers

Jobi Varghese

Sujatha Nagendra

Copyright © 2012, Oracle and/or its affiliates. All rights reserved.

Disclaimer

This document contains proprietary information and is protected by copyright and other intellectual property laws. You may copy and print this document solely for your own use in an Oracle training course. 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. If you find any problems in the document, please report them in writing to: Oracle University, 500 Oracle Parkway, Redwood Shores, California 94065 USA. This document is not warranted to be error-free.

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 RIGHTS

The U.S. Government's rights to use, modify, reproduce, release, perform, display, or disclose these training materials are restricted by the terms of the applicable Oracle license agreement and/or the applicable U.S. Government contract.

Trademark Notice

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

Contents

1 Grid Infrastructure: Overview

- Objectives 1-2
- Oracle Grid Infrastructure 1-3
- What Is a Cluster? 1-4
- What Is Clusterware? 1-5
- Oracle Clusterware 1-6
- Oracle Clusterware Architecture and Services 1-7
- Goals for Oracle Clusterware 1-8
- Oracle Clusterware Networking 1-9
- Oracle Grid Infrastructure for a Cluster 1-11
- Oracle Clusterware Initialization 1-12
- Clusterware Startup Details 1-13
- Clusterware Startup: The OHASD orarootagent 1-15
- Clusterware Startup Details: The CRSD orarootagent 1-17
- Clusterware Startup Details: The CRSD oraagent 1-18
- Clusterware Startup Details: The OHASD oraagent 1-19
- Grid Plug and Play 1-20
- Grid Naming Service 1-21
- Single Client Access Name 1-22
- Oracle Automatic Storage Management (ASM) 1-24
- ASM Key Features and Benefits 1-25
- ASM and Grid Infrastructure 1-26
- Quiz 1-27
- Summary 1-30
- Practice 1 Overview 1-31

2 RAC Concepts

- Objectives 2-2
- Overview of Oracle RAC 2-3
- RAC One Node Single-Instance High Availability 2-5
- Oracle RAC One Node 2-6
- Oracle RAC One Node and Oracle Clusterware 2-7
- Cluster-Aware Storage Solutions 2-8
- Oracle Cluster File System 2-9
- Benefits of Using RAC 2-10

- Clusters and Scalability 2-11
- Levels of Scalability 2-12
- Scaleup and Speedup 2-14
- Speedup/Scaleup and Workloads 2-15
- I/O Throughput Balanced: Example 2-16
- Performance of Typical Components 2-17
- Necessity of Global Resources 2-18
- Additional Memory Requirement for RAC 2-19
- Parallel Execution with RAC 2-20
- Summary 2-21

3 Installing and Configuring Oracle RAC

- Objectives 3-2
- Installing the Oracle Database Software 3-3
- Creating the Cluster Database 3-8
- Database Type Selection 3-9
- Database Identification 3-10
- Cluster Database Management Options 3-11
- Passwords for Database Schema Owners 3-12
- Database File Locations 3-13
- Recovery Configuration 3-14
- Database Content 3-15
- Initialization Parameters 3-16
- Database Storage Options 3-17
- Create the Database 3-18
- Monitoring Progress 3-19
- Postinstallation Tasks 3-20
- Checking Managed Targets 3-21
- Background Processes Specific to Oracle RAC 3-22
- Single Instance-to-RAC Conversion 3-24
- Considerations for Converting Single-Instance Databases to Oracle RAC 3-25
- Single-Instance Conversion Using the DBCA 3-26
- Conversion Steps 3-27
- Single-Instance Conversion Using rconfig 3-30
- Quiz 3-32
- Summary 3-34
- Practice 3 Overview 3-35

4 Oracle RAC Administration

- Objectives 4-2
- Cluster Database Home Page 4-3

- Cluster Database Instance Home Page 4-5
- Cluster Home Page 4-6
- Configuration Section 4-7
- Topology Viewer 4-9
- Enterprise Manager Alerts and RAC 4-10
- Enterprise Manager Metrics and RAC 4-11
- Enterprise Manager Alert History and RAC 4-13
- Enterprise Manager Blackouts and RAC 4-14
- Redo Log Files and RAC 4-15
- Automatic Undo Management and RAC 4-16
- Starting and Stopping RAC Instances 4-17
- Starting and Stopping RAC Instances with srvctl 4-18
- Starting and Stopping RAC Instances with SQL*Plus 4-19
- Switch Between Automatic and Manual Policies 4-20
- RAC Initialization Parameter Files 4-21
- SPFILE Parameter Values and RAC 4-22
- EM and SPFILE Parameter Values 4-23
- RAC Initialization Parameters 4-25
- Parameters That Require Identical Settings 4-27
- Parameters That Require Unique Settings 4-28
- Quiescing RAC Databases 4-29
- Terminating Sessions on a Specific Instance 4-30
- How SQL*Plus Commands Affect Instances 4-31
- Transparent Data Encryption and Wallets in RAC 4-32
- Quiz 4-33
- Summary 4-35
- Practice 4 Overview 4-36

5 Managing Backup and Recovery for RAC

- Objectives 5-2
- RAC and Instance Recovery 5-3
- Instance Recovery and Database Availability 5-5
- Instance Recovery and RAC 5-6
- Protecting Against Media Failure 5-8
- Media Recovery in Oracle RAC 5-9
- Parallel Recovery in RAC 5-10
- Archived Log File Configurations 5-11
- RAC and the Fast Recovery Area 5-12
- RAC Backup and Recovery Using EM 5-13
- Configuring RAC Recovery Settings with EM 5-14
- Archived Redo File Conventions in RAC 5-15

Configuring RAC Backup Settings with EM 5-16
Oracle Recovery Manager 5-17
Configuring RMAN Snapshot Control File Location 5-18
Configuring Control File and SPFILE Autobackup 5-19
Crosschecking on Multiple RAC Clusters Nodes 5-20
Channel Connections to Cluster Instances 5-21
RMAN Channel Support for the Grid 5-22
RMAN Default Autolocation 5-23
Distribution of Backups 5-24
Shared Storage Backup Scheme: One Local Drive 5-25
Shared Storage Backup Scheme: Multiple Drives 5-26
Restoring and Recovering 5-27
Quiz 5-28
Summary 5-30
Practice 5 Overview 5-31
Objectives 6-2
Need for Global Concurrency Control 6-3
Global Resource Directory (GRD) 6-4
Global Resource Management 6-5
Global Resource Remastering 6-6
Global Resource Recovery 6-7
Global Resource Background Processes 6-8
Global Resource Access Coordination 6-10
Global Enqueues 6-11
Instance Locks 6-12
Global Cache Management: Overview 6-13
Global Cache Management Components 6-14
Global Cache Buffer States 6-15
Global Cache Management Scenarios for Single Block Reads 6-16
Global Cache Scenarios: Overview 6-17
Scenario 1: Read From Disk 6-18
Scenario 2: Read-Write Cache Fusion 6-22
Scenario 3: Write-Write Cache Fusion 6-26
Scenario 4: Write-Read Cache Fusion 6-30
Global Cache Management Scenarios for Multi-Block Reads 6-34
Useful Global Resource Management Views 6-35
Quiz 6-36
Summary 6-37

7 RAC Database Monitoring and Tuning

- Objectives 7-2
- CPU and Wait Time Tuning Dimensions 7-3
- RAC-Specific Tuning 7-4
- Analyzing Cache Fusion Impact in RAC 7-5
- Typical Latencies for RAC Operations 7-6
- Wait Events for RAC 7-7
- Wait Event Views 7-8
- Global Cache Wait Events: Overview 7-9
- Global Enqueue Waits 7-11
- Session and System Statistics 7-12
- Most Common RAC Tuning Tips 7-13
- Index Block Contention: Considerations 7-15
- Oracle Sequences and Index Contention 7-16
- Undo Block Considerations 7-17
- High-Water Mark Considerations 7-18
- Concurrent Cross-Instance Calls: Considerations 7-19
- Monitoring RAC Database and Cluster Performance 7-20
- Cluster Database Performance Page 7-21
- Determining Cluster Host Load Average 7-22
- Determining Global Cache Block Access Latency 7-23
- Determining Average Active Sessions 7-24
- Determining Database Throughput 7-25
- Accessing the Cluster Cache Coherency Page 7-27
- Viewing the Cluster Interconnects Page 7-29
- Viewing the Database Locks Page 7-31
- AWR Snapshots in RAC 7-32
- AWR Reports and RAC: Overview 7-33
- Active Session History Reports for RAC 7-35
- Automatic Database Diagnostic Monitor for RAC 7-37
- What Does ADDM Diagnose for RAC? 7-39
- EM Support for ADDM for RAC 7-40
- Quiz 7-41
- Summary 7-43
- Practice 7 Overview 7-44

8 Managing High Availability of Services

- Objectives 8-2
- Oracle Services 8-3
- Services for Policy- and Administrator-Managed Databases 8-4
- Default Service Connections 8-5

Creating Service with Enterprise Manager 8-6
Creating Services with SRVCTL 8-7
Managing Services with Enterprise Manager 8-8
Managing Services with EM 8-9
Managing Services with srvctl 8-10
Using Services with Client Applications 8-11
Services and Connection Load Balancing 8-12
Services and Transparent Application Failover 8-13
Using Services with the Resource Manager 8-14
Services and Resource Manager with EM 8-15
Using Services with the Scheduler 8-16
Services and the Scheduler with EM 8-17
Using Distributed Transactions with RAC 8-19
Distributed Transactions and Services 8-20
Service Thresholds and Alerts 8-22
Services and Thresholds Alerts: Example 8-23
Service Aggregation and Tracing 8-24
Top Services Performance Page 8-25
Service Aggregation Configuration 8-26
Service, Module, and Action Monitoring 8-27
Service Performance Views 8-28
Quiz 8-29
Summary 8-31
Practice 8 Overview 8-32

9 High Availability of Connections

Objectives 9-2
Types of Workload Distribution 9-3
Client-Side Connect-Time Load Balancing 9-4
Client-Side Connect-Time Failover 9-5
Server-Side Connect-Time Load Balancing 9-6
Fast Application Notification: Overview 9-7
Fast Application Notification: Benefits 9-8
FAN-Supported Event Types 9-9
FAN Event Status 9-10
FAN Event Reasons 9-11
FAN Event Format 9-12
Load Balancing Advisory: FAN Event 9-13
Server-Side Callouts Implementation 9-14
Server-Side Callout Parse: Example 9-15
Server-Side Callout Filter: Example 9-16

Server-Side ONS 9-17
Optionally Configuring the Client-Side ONS 9-18
UCP JDBC Fast Connection Failover: Overview 9-19
Using Oracle Streams Advanced Queuing for FAN 9-20
JDBC/ODP.NET FCF Benefits 9-21
Load Balancing Advisory 9-22
UCP JDBC/ODP.NET Runtime Connection Load Balancing: Overview 9-23
Connection Load Balancing in RAC 9-24
Load Balancing Advisory: Summary 9-25
Monitoring LBA FAN Events 9-26
FAN Release Map 9-27
Transparent Application Failover: Overview 9-28
TAF Basic Configuration Without FAN: Example 9-29
TAF Basic Configuration with FAN: Example 9-30
TAF Preconnect Configuration: Example 9-31
TAF Verification 9-32
FAN Connection Pools and TAF Considerations 9-33
Summary 9-34

10 Upgrading and Patching Oracle RAC

Objectives 10-2
Types of Patches 10-3
Patch Properties 10-5
Configuring the Software Library 10-6
Setting Up Patching 10-7
Obtaining Oracle RAC Patches 10-8
Downloading Patches 10-11
Reduced Down-Time Patching for Cluster Environments 10-12
Rolling Patches 10-13
Out-of-Place Database Upgrades 10-14
Out-of-Place Database Upgrade with OUI 10-15
OPatch: General Usage 10-16
Before Patching with OPatch 10-17
OPatch Automation 10-18
OPatch Automation Examples 10-19
Quiz 10-21
Summary 10-22
Lesson 10 Practice Overview 10-23

11 Oracle RAC One Node

- Objectives 11-2
- Verifying an Existing RAC One Node Database 11-3
- Oracle RAC One Node Online Migration 11-4
- Online Migration Considerations 11-5
- Performing an Online Migration 11-6
- Online Migration Illustration 11-7
- Online Maintenance: Rolling Patches 11-10
- Adding an Oracle RAC One Node Database to an Existing Cluster 11-12
- Converting a RAC One Node Database to RAC 11-13
- Converting a Single Instance Database to RAC One Node 11-15
- Converting a RAC Database to RAC One Node 11-16
- Quiz 11-17
- Summary 11-19
- Lesson 11 Practice Overview 11-20

12 Quality of Service Management

- Lesson Objectives 12-2
- QoS Management Background 12-3
- QoS Management Overview 12-4
- QoS Management and Exadata Database Machine 12-5
- QoS Management Focus 12-6
- QoS Management Benefits 12-7
- QoS Management Functional Overview 12-9
- QoS Management Policy Sets 12-11
- Server Pools 12-12
- Performance Classes 12-14
- Classification and Tagging 12-16
- Performance Policies 12-17
- Performance Class Ranks 12-18
- Performance Objectives 12-19
- Performance Satisfaction Metrics 12-20
- Server Pool Directive Overrides 12-21
- Overview of Metrics 12-22
- QoS Management Architecture 12-24
- QoS Management Recommendations 12-25
- Implementing Recommendations 12-27
- Quiz 12-29
- Summary 12-31
- Lesson 12 Demonstrations 12-32

13 Design for High Availability

- Objectives 13-2
- Causes of Unplanned Down Time 13-3
- Causes of Planned Down Time 13-4
- Oracle's Solution to Down Time 13-5
- RAC and Data Guard Complementarity 13-6
- Maximum Availability Architecture 13-7
- RAC and Data Guard Topologies 13-8
- RAC and Data Guard Architecture 13-9
- Data Guard Broker (DGB) and Oracle Clusterware (OC) Integration 13-11
- Fast-Start Failover: Overview 13-12
- Data Guard Broker Configuration Files 13-14
- Real-Time Query Physical Standby Database 13-15
- Hardware Assisted Resilient Data 13-16
- Database High Availability: Best Practices 13-17
- How Many ASM Disk Groups Per Database? 13-18
- Which RAID Configuration for High Availability? 13-19
- Should You Use ASM Mirroring Protection? 13-20
- What Type of Striping Works Best? 13-21
- ASM Striping Only 13-22
- Hardware RAID–Striped LUNs 13-23
- Hardware RAID–Striped LUNs HA 13-24
- Disk I/O Design Summary 13-25
- Extended RAC: Overview 13-26
- Extended RAC Connectivity 13-27
- Extended RAC Disk Mirroring 13-28
- Achieving Quorum with Extended RAC 13-29
- Additional Data Guard Benefits 13-30
- Using a Test Environment 13-31
- Quiz 13-32
- Summary 13-33

