

Oracle Grid Infrastructure 11g: Manage Clusterware and ASM

Volume I • Student Guide

D59999GC10

Edition 1.0

September 2010

D65405

ORACLE®

Authors

James Womack

James Spiller

Technical Contributors

David Brower

Jean-Francois Verrier

Mark Fuller

Mike Leatherman

Barb Lundhild

S. Matt Taylor

Rick Wessman

Technical Reviewers

Christopher Andrews

Christian Bauwens

Michael Cebulla

Jonathan Creighton

Al Flournoy

Andy Fortunak

Joel Goodman

Michael Hazel

Pete Jones

Jerry Lee

Markus Michalewicz

Peter Sharman

Ranbir Singh

Linda Smalley

Janet Stern

Richard Strohm

Branislav Valny

Doug Williams

Publishers

Jayanthy Keshavamurthy

Giri Venugopal

Copyright © 2010, 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 Oracle Grid Infrastructure Architecture

Objectives 1-2

Oracle Grid Infrastructure 1-3

Module 1: Oracle Clusterware Concepts 1-4

What Is a Cluster? 1-5

What Is Clusterware? 1-6

Oracle Clusterware 1-7

Oracle Clusterware Architecture and Services 1-8

Goals for Oracle Clusterware 1-9

Oracle Clusterware Networking 1-10

Interconnect Link Aggregation: Single Switch 1-12

Interconnect Link Aggregation: Multiswitch 1-14

Interconnect NIC Guidelines 1-15

Additional Interconnect Guidelines 1-16

Quiz 1-17

Module 2: Oracle Clusterware Architecture 1-18

Oracle Clusterware Startup 1-19

Oracle Clusterware Process Architecture 1-20

Grid Plug and Play 1-22

GPnP Domain 1-23

GPnP Components 1-24

GPnP Profile 1-25

Grid Naming Service 1-26

Single Client Access Name 1-27

GPnP Architecture Overview 1-29

How GPnP Works: Cluster Node Startup 1-31

How GPnP Works: Client Database Connections 1-32

Quiz 1-33

Module 3: ASM Architecture 1-35

ASM and ASM Cluster File System 1-37

ASM Key Features and Benefits 1-39

ASM Instance Designs: Nonclustered ASM and Oracle Databases 1-40

ASM Instance Designs: Clustered ASM for Clustered Databases 1-41

ASM Instance Designs: Clustered ASM for Mixed Databases 1-42

- ASM System Privileges 1-43
- ASM OS Groups with Role Separation 1-44
- Authentication for Accessing ASM Instances 1-45
- Password-Based Authentication for ASM 1-46
- Managing the ASM Password File 1-47
- Using a Single OS Group 1-48
- Using Separate OS Groups 1-49
- ASM Components: Software 1-50
- ASM Components: ASM Instance 1-51
- ASM Components: ASM Instance Primary Processes 1-53
- ASM Components: Node Listener 1-54
- ASM Components: Configuration Files 1-55
- ASM Components: Group Services 1-56
- ASM Components: ASM Disk Group 1-57
- ASM Disk Group: Failure Groups 1-58
- ASM Components: ASM Disks 1-59
- ASM Components: ASM Files 1-60
- ASM Files: Extents and Striping 1-61
- ASM Files: Mirroring 1-62
- ASM Components: ASM Clients 1-63
- ASM Components: ASM Utilities 1-64
- ASM Scalability 1-65
- Summary 1-66

2 Grid Infrastructure Installation

- Objectives 2-2
- Module 1: Preinstallation Planning 2-3
 - Shared Storage Planning for Grid Infrastructure 2-4
 - Sizing Shared Storage 2-5
 - Storing the OCR in ASM 2-6
 - Oracle Clusterware Repository (OCR) 2-7
 - Managing Voting Disks in ASM 2-9
 - CSS Voting Disk Function 2-10
 - Oracle Clusterware Main Log Files 2-11
 - Installing ASMLib 2-12
 - Preparing ASMLib 2-13
 - Quiz 2-14
- Module 2: Grid Infrastructure Preinstallation Tasks 2-15
 - Oracle Grid Infrastructure 11g Installation 2-16
 - Checking System Requirements 2-17

- Checking Network Requirements 2-18
- Software Requirements (Kernel) 2-20
- Software Requirements: Packages 2-21
- Oracle Validated Configuration RPM 2-22
- Creating Groups and Users 2-24
- Creating Groups and Users: Example 2-25
- Shell Settings for the Grid Infrastructure User 2-26
- Quiz 2-28
- Module 3: Grid Infrastructure Installation 2-29
 - Installing Grid Infrastructure 2-30
 - Grid Plug and Play Support 2-31
 - Cluster Node Information 2-32
 - Specify Network Interface Usage 2-33
 - Storage Option Information 2-34
 - Specify Cluster Configuration 2-35
 - Install Locations 2-37
 - Failure Isolation Support with IPMI 2-38
 - Privileged Operating System Groups 2-39
 - Installation and Inventory Locations 2-40
 - Prerequisite Checks 2-41
 - Finishing the Installation 2-42
 - Verifying the Grid Infrastructure Installation 2-43
- Module 4: Configuring ASM Disk Groups and ACFS 2-44
 - Configuring ASM with ASMCA 2-45
 - Creating an ASM Disk Group with ASMCA 2-46
 - Creating an ASM Disk Group: Advanced Options 2-47
 - Creating a Disk Group with Enterprise Manager 2-48
 - Creating an ASM Disk Group with Command-Line Tools 2-50
 - Configuring an ASM Volume: ASMCA 2-51
 - Configuring an ASM Volume: EM 2-52
 - Configuring an ASM Volume: ASMCMD and SQL 2-53
 - Configuring the ASM Cluster File System 2-54
 - Configuring ACFS with EM 2-55
 - Configuring ACFS with Command Line 2-56
 - Mounting ACFS with ASMCA 2-57
 - Mounting an ACFS with EM 2-58
 - Mounting ACFS with Command-Line Tools 2-59
 - Quiz 2-60
 - Summary 2-61
 - Practice 2 Overview 2-62

3 Administering Oracle Clusterware

- Objectives 3-2
- Managing Oracle Clusterware 3-3
- Managing Clusterware with Enterprise Manager 3-4
- Controlling Oracle Clusterware 3-5
- Verifying the Status of Oracle Clusterware 3-6
- Determining the Location of Oracle Clusterware Configuration Files 3-7
- Checking the Integrity of Oracle Clusterware Configuration Files 3-8
- Backing Up and Recovering the Voting Disk 3-9
- Adding, Deleting, or Migrating Voting Disks 3-10
- Locating the OCR Automatic Backups 3-11
- Changing the Automatic OCR Backup Location 3-12
- Adding, Replacing, and Repairing OCR Locations 3-13
- Removing an Oracle Cluster Registry Location 3-14
- Migrating OCR Locations to ASM 3-15
- Migrating OCR from ASM to Other Shared Storage 3-16
- Performing Manual OCR Backups 3-17
- Recovering the OCR by Using Physical Backups 3-18
- Recovering the OCR by Using Logical Backups 3-19
- Oracle Local Registry 3-20
- Determining the Current Network Settings 3-22
- Changing the Public VIP Addresses 3-23
- Changing the Interconnect Adapter 3-25
- Managing SCAN VIP and SCAN Listener Resources 3-27
- Quiz 3-30
- Summary 3-32
- Practice 3 Overview 3-33

4 Managing Oracle Clusterware

- Module 4-1 Adding and Deleting Oracle Clusterware Homes 4-2
- Objectives 4-3
- Adding Oracle Clusterware Homes 4-4
- Prerequisite Steps for Running `addNode.sh` 4-5
- Adding a Node with `addNode.sh` 4-7
- Completing OUI Silent Node Addition 4-8
- Removing a Node from the Cluster 4-9
- Deleting a Node from the Cluster 4-10
- Deleting a Node from a Cluster (GNS in Use) 4-13
- Deleting a Node from the Cluster 4-14
- Quiz 4-15
- Summary 4-16

- Module 4-2 Patching Oracle Clusterware 4-17
 - Objectives 4-18
 - Out-of-Place Oracle Clusterware Upgrade 4-19
 - Oracle Clusterware Upgrade 4-20
 - Types of Patches 4-21
 - Patch Properties 4-23
 - Configuring the Software Library 4-24
 - Setting Up Patching 4-25
 - Starting the Provisioning Daemon 4-26
 - Obtaining Oracle Clusterware Patches 4-27
 - Uploading Patches 4-29
 - Deployment Procedure Manager 4-31
 - Reduced Down-Time Patching for Cluster Environments 4-32
 - Rolling Patches 4-33
 - Checking Software Versions 4-34
 - Installing a Rolling Patchset with OUI 4-35
 - Patchset OUI 4-36
 - Installing a Rolling Patchset with OUI 4-37
 - OPatch: Overview 4-38
 - OPatch: General Usage 4-40
 - Before Patching with OPatch 4-41
 - Installing a Rolling Patch with OPatch 4-42
 - Installing a Patch with Minimum Down Time with OPatch 4-44
 - Quiz 4-45
 - Summary 4-47

5 Making Applications Highly Available with Oracle Clusterware

- Objectives 5-2
- Oracle Clusterware High Availability (HA) 5-3
- Oracle Clusterware HA Components 5-4
- Resource Management Options 5-5
- Server Pools 5-6
- Server Pool Attributes 5-7
- GENERIC and FREE Server Pools 5-9
- Assignment of Servers to Server Pools 5-11
- Server Attributes and States 5-12
- Creating Server Pools with `srvctl` and `crsctl` 5-14
- Managing Server Pools with `srvctl` and `crsctl` 5-15
- Adding Server Pools with Enterprise Manager 5-16

- Managing Server Pools with Enterprise Manager 5-17
- Clusterware Resource Modeling 5-18
- Resource Types 5-20
- Adding a Resource Type 5-21
- Resource Type Parameters 5-23
- Resource Type Advanced Settings 5-24
- Defining Resource Dependencies 5-25
- Creating an Application VIP by Using `crsctl` 5-27
- Creating an Application VIP by Using EM 5-29
- Managing Clusterware Resources with EM 5-30
- Adding Resources with EM 5-31
- Adding Resources by Using `crsctl` 5-36
- Managing Resources with EM 5-37
- Managing Resources with `crsctl` 5-40
- HA Events: ONS and FAN 5-42
- Managing Oracle Notification Server with `srvctl` 5-43
- Quiz 5-44
- Summary 5-46
- Practice 5 Overview 5-47

6 Troubleshooting Oracle Clusterware

- Objectives 6-2
- Golden Rule in Debugging Oracle Clusterware 6-3
- Oracle Clusterware Main Log Files 6-5
- Diagnostics Collection Script 6-6
- Cluster Verify: Overview 6-7
- Cluster Verify Components 6-8
- Cluster Verify Locations 6-9
- Cluster Verify Configuration File 6-10
- Cluster Verify Output: Example 6-12
- Enabling Resource Debugging 6-13
- Dynamic Debugging 6-15
- Enabling Tracing for Java-Based Tools 6-17
- Preserving Log Files Before Wrapping 6-18
- Process Roles for Node Reboots 6-19
- Determining Which Process Caused Reboot 6-21
- Using `ocrdump` to View Logical Contents of the OCR 6-22
- Checking the Integrity of the OCR 6-23
- OCR-Related Tools for Debugging 6-24

Browsing My Oracle Support Knowledge Articles 6-26
Quiz 6-27
Summary 6-29
Practice 6 Overview 6-30

7 Administering ASM Instances

Objectives 7-2
ASM Initialization Parameters 7-3
ASM_DISKGROUPS 7-4
Disk Groups Mounted at Startup 7-5
ASM_DISKSTRING 7-6
ASM_POWER_LIMIT 7-8
INSTANCE_TYPE 7-9
CLUSTER_DATABASE 7-10
MEMORY_TARGET 7-11
Adjusting ASM Instance Parameters in SPFILEs 7-12
Starting and Stopping ASM Instances by Using `srvctl` 7-13
Starting and Stopping ASM Instances by Using SQL*Plus 7-14
Starting and Stopping ASM Instances by Using ASMCA and ASMCMD 7-16
Starting and Stopping ASM Instances Containing Cluster Files 7-17
Starting and Stopping the Node Listener 7-18
ASM Dynamic Performance Views 7-19
ASM Dynamic Performance Views Diagram 7-20
Quiz 7-22
Summary 7-24
Practice 7 Overview: Administering ASM Instances 7-25

8 Administering ASM Disk Groups

Objectives 8-2
Disk Group Overview 8-3
Creating a New Disk Group 8-4
Creating a New Disk Group with ASMCMD 8-6
Disk Group Attributes 8-7
V\$ASM_ATTRIBUTE 8-9
Compatibility Attributes 8-10
Features Enabled by Disk Group Compatibility Attributes 8-11
Support for 4KB Sector Disk Drives 8-12
Supporting 4 KB Sector Disks 8-13
ASM Support for 4KB Sector Disks 8-14
Using the `SECTOR_SIZE` Clause 8-15

Viewing ASM Disk Groups 8-17
Viewing ASM Disk Information 8-19
Extending an Existing Disk Group 8-21
Dropping Disks from an Existing Disk Group 8-22
REBALANCE POWER 0 8-23
V\$ASM_OPERATION 8-24
Adding and Dropping in the Same Command 8-25
Adding and Dropping Failure Groups 8-26
Undropping Disks in Disk Groups 8-27
Mounting and Dismounting Disk Groups 8-28
Viewing Connected Clients 8-29
Dropping Disk Groups 8-30
Checking the Consistency of Disk Group Metadata 8-31
ASM Fast Mirror Resync 8-32
Preferred Read Failure Groups 8-33
Preferred Read Failure Groups Best Practice 8-34
Viewing ASM Disk Statistics 8-35
Performance, Scalability, and Manageability Considerations for Disk Groups 8-37
Quiz 8-38
Summary 8-40
Practice 8 Overview: Administering ASM Disk Groups 8-41

9 Administering ASM Files, Directories, and Templates

Objectives 9-2
ASM Clients 9-3
Interaction Between Database Instances and ASM 9-5
Accessing ASM Files by Using RMAN 9-6
Accessing ASM Files by Using XML DB 9-8
Accessing ASM Files by Using `DBMS_FILE_TRANSFER` 9-9
Accessing ASM Files by Using `ASMCMD` 9-10
Fully Qualified ASM File Names 9-11
Other ASM File Names 9-13
Valid Contexts for the ASM File Name Forms 9-15
Single File Creation Examples 9-16
Multiple File Creation Example 9-17
View ASM Aliases, Files, and Directories 9-18
Viewing ASM Files 9-20
ASM Directories 9-21
Managing ASM Directories 9-22
Managing Alias File Names 9-23

- ASM Intelligent Data Placement 9-24
- Guidelines for Intelligent Data Placement 9-25
- Assigning Files to Disk Regions 9-26
- Assigning Files to Disk Regions with Enterprise Manager 9-27
- Monitoring Intelligent Data Placement 9-28
- Disk Group Templates 9-29
- Viewing Templates 9-31
- Managing Disk Group Templates 9-32
- Managing Disk Group Templates with ASMCMD 9-33
- Using Disk Group Templates 9-34
- ASM Access Control Lists 9-35
- ASM ACL Prerequisites 9-36
- Managing ASM ACL with SQL Commands 9-37
- Managing ASM ACL with ASMCMD Commands 9-38
- Managing ASM ACL with Enterprise Manager 9-39
- ASM ACL Guidelines 9-41
- Quiz 9-42
- Summary 9-44

10 Administering ASM Cluster File Systems

- Objectives 10-2
- ASM Files and Volumes 10-3
- ACFS and ADVM Architecture Overview 10-4
- ADVM Processes 10-6
- ADVM Restrictions 10-7
- ASM Cluster File System 10-8
- ADVM Space Allocation 10-9
- Striping Inside the Volume 10-10
- Volume Striping: Example 10-11
- Creating an ACFS Volume 10-13
- Create an ASM Dynamic Volume with Enterprise Manager 10-14
- Managing ADVM Dynamic Volumes 10-17
- Create an ASM Cluster File System with Enterprise Manager 10-18
- Manage Dynamic Volumes with SQL*PLUS 10-19
- Registering an ACFS Volume 10-20
- Creating an ACFS Volume with ASMCA 10-21
- Creating the ACFS File System with ASMCA 10-22
- Mounting the ACFS File System with ASMCA 10-23
- Managing ACFS with EM 10-24
- Extending ASMCMD for Dynamic Volumes 10-25
- Linux-UNIX File System APIs 10-26

Linux-UNIX Extensions 10-27
ACFS Platform-Independent Commands 10-28
ACFS Snapshots 10-29
Managing ACFS Snapshots 10-30
Managing ACFS Snapshots with Enterprise Manager 10-32
Creating ACFS Snapshots 10-33
Managing Snapshots 10-34
Viewing Snapshots 10-35
ACFS Backups 10-36
ACFS Performance 10-37
Using ACFS Volumes After Reboot 10-38
ACFS Views 10-39
Quiz 10-40
Summary 10-41
Practice 10 Overview: Managing ACFS 10-42

A Practices and Solutions

B DHCP and DNS Configuration For GNS

Objectives B-2
GNS Overview B-3
DHCP Service B-4
DHCP Configuration Example B-5
DNS Concepts B-7
DNS Forwarding For GNS B-9
DNS Configuration: Example B-11
DNS Configuration: Detail B-13
Summary B-17

C High Availability of Connections

Objectives C-2
Types of Workload Distribution C-3
Client-Side Load Balancing C-4
Client-Side, Connect-Time Failover C-5
Server-Side Load Balancing C-7
Runtime Connection Load Balancing and Connection Pools C-9
Fast Application Notification: Overview C-11
Fast Application Notification: Benefits C-12
FAN Events C-13
FAN Event Status C-14

FAN Event Reasons C-15
FAN Event Format C-16
Load Balancing Advisory: FAN Event C-17
Implementation of Server-Side Callouts C-18
Server-Side Callout Parse: Example C-19
Server-Side Callout Filter: Example C-20
Configuring the Server-Side ONS C-21
Optionally Configure the Client-Side ONS C-22
JDBC Fast Connection Failover: Overview C-23
Using Oracle Streams Advanced Queuing for FAN C-24
JDBC/ODP.NET FCF Benefits C-25
Load Balancing Advisory C-26
Runtime Connection Load Balancing and Connection Pools C-27
Monitor LBA FAN Events C-28
Transparent Application Failover: Overview C-29
TAF Basic Configuration Without FAN: Example C-30
TAF Basic Configuration with FAN: Example C-31
TAF Preconnect Configuration: Example C-32
TAF Verification C-33
FAN Connection Pools and TAF Considerations C-34
Summary C-35

D Oracle RAC One Node

Oracle RAC One Node D-2
The Omotion Utility D-3
Oracle RAC One Node and OVM D-4
Creating and Managing RAC One Node D-5

E Cloning Oracle Clusterware

Objectives E-2
What Is Cloning? E-3
Benefits of Cloning Oracle Clusterware E-4
Creating a Cluster by Cloning Oracle Clusterware E-5
Preparing the Oracle Clusterware Home for Cloning E-6
Cloning to Create a New Oracle Clusterware Environment E-9
The `clone.pl` Script E-11
The `clone.pl` Environment Variables E-12
The `clone.pl` Command Options E-13
Cloning to Create a New Oracle Clusterware Environment E-14

Log Files Generated During Cloning E-18
Cloning to Extend Oracle Clusterware to More Nodes E-20
Quiz E-25
Summary E-27

F Clusterware Concepts

Objectives F-2
Oracle Grid Infrastructure F-3
What Is a Cluster? F-4
What Is Clusterware? F-5
Oracle Clusterware F-6
Oracle Clusterware Architecture and Services F-7
Oracle Clusterware Networking F-8
Oracle Clusterware Startup F-10
Oracle Clusterware Process Architecture F-11
Grid Plug and Play F-13
GPnP Domain F-14
GPnP Components F-15
GPnP Profile F-16
Grid Naming Service F-17
Single Client Access Name F-18
GPnP Architecture Overview F-20
How GPnP Works: Cluster Node Startup F-22
How GPnP Works: Client Database Connections F-23
Summary F-24

G RAC Concepts

Objectives G-2
Benefits of Using RAC G-3
Clusters and Scalability G-4
Levels of Scalability G-5
Scaleup and Speedup G-6
Speedup/Scaleup and Workloads G-7
I/O Throughput Balanced: Example G-8
Performance of Typical Components G-9
Necessity of Global Resources G-10
Global Resources Coordination G-11
Global Cache Coordination: Example G-12
Write to Disk Coordination: Example G-13
Dynamic Reconfiguration G-14

Object Affinity and Dynamic Remastering G-15
Global Dynamic Performance Views G-16
Efficient Internode Row-Level Locking G-17
Parallel Execution with RAC G-18
Summary G-19

