Comprehensive, End-to-End Insight into Oracle's Flagship Database Machine

Oracle Exadata

EXPERT'S HANDBOOK

Tariq Farooq | Charles Kim | Nitin Vengurlekar
Sridhar Avantsa | Guy Harrison | Syed Jaffar Hussain

Oracle Exadata Expert's Handbook

Oracle Exadata Expert's Handbook

Table of Contents

Contents
Preface
Acknowledgments
About the Authors
About the Technical Reviewers and Contributors
Chapter 1 360-Degree Overview of Exadata
- An Exadata Synopsis
  - An Engineered Database Machine
  - How Exadata Changes Your Job Role
  - Oracle Enterprise Manager 12c
- Hardware Architecture
  - Server LayerCompute Nodes
  - Shared StorageStorage Cells
  - Networking FabricInfiniBand
  - Power Distribution Units (PDUs)
  - Cisco Switch
  - 2u Custom Network Switch Space
- Software Architecture
  - Real Application Clusters (RAC)
  - Automatic Storage Management (ASM)
  - DB Compute Nodes
  - Storage Cell Software
- Models and Configuration Options

Table of Contents

Historical Synopsis

The Evolution of Exadata

Exadata SuperCluster T4-4

Exadata SuperCluster T5-8

Exadata SuperCluster M6-32

Exadata Storage Expansion Racks

Exadata Storage Cells

Hardware Progression

Examining an Exadata Machine

Summary

Chapter 2 Real Application Clusters (RAC) in Exadata

The Significance of RAC in Exadata

An Overview of RAC

A Quick Primer on RAC in Exadata

How RAC Affects DBAs

Setting Up RAC Clusters in Exadata

Operational Best Practices

Maximum Availability Architecture (MAA)

Optimal and Efficient Databases in RAC

Managing RAC with OEM 12c

Common Utilities and Commands

Troubleshooting and Tuning RAC

Start with ORAchk

Employ the TFA Collector Utility

Use the Automatic Diagnostic Repository

Check the Alert and Trace Log Files

Employ the Three As

Check the Private Cluster Interconnect

Table of Contents

Enable Tracing and Inspect the Trace Logs
Cluster Health Monitor
Employ Oracle Enterprise Manager 12c
Miscellaneous Tools and Utilities
Useful Oracle Support Resources
Summary
Chapter 3 The Secret Sauce: Exadata Storage Cells
An Overview of Exadata Storage Server
Storage Server Architecture
Cell Software Components and Management
Configuring Mail Server for Alert Notifications
Displaying Cell Server Details
Cell Metrics and Alert History
Querying Cell Alert History
Querying GV$ Views
Storage Architecture and Formulation
Disk Architecture in Non-Exadata
Disk Architecture in Exadata
System Users for Cell Administration
Listing Disk Levels
Configuring Cell Disks
Creating Grid Disks
Configuring Flash Grid Disks
Creating an ASM Disk Group
Managing the Cell Server
Troubleshooting the Cell Server
SunDiag
ExaWatcher

Table of Contents

Exachk

CheckHWnFWProfile

Storage Cell Startup and Shutdown

Solving Disk Problems

Enforcing Cell Security

Configuring ASM-Scoped Security

Configuring Database-Scoped Security

Exempting Cell Security

Summary

Chapter 4 Flash Cache, Smart Scans, and Cell Offloading

Concepts of Exadata Flash Cache

Why Flash Cache Is Necessary

Evolution of Flash Cache in Exadata

Storage Server and Flash Cache

The Exadata Smart Flash Cache Feature

Populating the Flash Cache

Exadata Smart Flash Logging

The Database and Flash Cache

Smart Scans and Cell Offloading

Storage Indexes

Caching Data in the Flash Cache

Summary

Chapter 5 Exadata Compression: HCC Demystified

Columnar Storage Models

The PAX Model

Fractured Mirrors

Fine-Grained Hybrids

Table of Contents

Oracle Implementation of DSMHybrid Columnar Compression

Compression within Oracle Databases

The Concepts of HCC

Compression Ratios

Compression Types and Compression Units

HCC and Performance

Bulk Load Operations

Bulk Read I/O Operations

Small I/O Operations

HCC and DML

HCC and Locking

Practical Uses of HCC

Summary

Chapter 6 Oracle Database 12c and Exadata

12c Partitioning Features

Partial Indexes

Partition Index Maintenance

Partition Move

New 12c Optimizer Features

Adaptive Plans

Automatic Re-optimization

Dynamic Adaptive Statistics

Information Lifecycle Management

Application Continuity

Multitenant Architecture

Overview

PDB: A New Consolidation Model

Unplug/Plug Operations

Table of Contents

RAC and PDB

Exadata Software Updates

Summary

Chapter 7 Exadata Networking: Management and Administration

Exadata Network Components

The Role of the InfiniBand Network

Network Architecture

Network Setup Requirements

Troubleshooting Tools and Utilities

Physical Link Monitoring

Log Files Collection

Integrated Lights Out Manager

OEM Cloud Control 12c

Summary

Chapter 8 Backup and Recovery and Data Guard

RMAN Disk-to-Disk Backups

Settings for RMAN Backups on the Exadata

rman2disk Shell Script

rman2disk Template Files

Using rman2disk

Creating RMAN Backups

RMAN Backup Schedule

Container and Pluggable Databases

Data Guard

Patches

Session Data Unit

Bandwidth-Delay Product

Table of Contents

Network Queue Size
Disabling TCP Nagle Algorithm
Enabling Network Time Protocol
Block Change Tracking
Fast Recovery Area
Automatic Archive Switch
Parallel Execution Message Size
Database Cache Size
Standby Redo Logs
Force Logging
Flashback Logging
Real-Time Apply
Timeout and Reopen Options
Archive Generation Rate
Standby File Management
Data Guard Standby-First Patching
Active Data Guard
Far Sync
Archive Log Retention Policy
Data Corruptions
Data Guard Instantiation
Configuring Data Guard Broker
OEM Cloud Control 12c
Switchover Considerations
Switchover Tracing
Guaranteed Restore Point
Summary
Chapter 9 Managing Exadata with OEM 12c
Exadata Targets Discovery

Table of Contents

Exadata Monitoring Architecture

Oracle Exadata Plugins

Prerequisite Checks

Manual Deployment

Exadata Database Machine Discovery

Prerequisite Checks

Launching Exadata Discovery

Post-Discovery Procedure

Exadata Components

Monitoring and Management

Administration

Summary

Chapter 10 Migrating to Exadata

Exadata Implementation Lifecycle

Phase I: Architectural Strategy

Sizing the Specific Exadata Solution

Phase II: Planning and Design

Custom versus Third-Party Applications

Choosing Exadata Features to Implement

Accounting for the Paradigm Change

Determining Migration Strategies

Phase III: Migration Testing

Backup and Recovery Strategy

Exadata Monitoring and Alerting

Exadata Patching

Exadata Migration Best Practices

Summary

Chapter 11 Upgrading and Patching Exadata and ZFS

Table of Contents

Storage Appliance

Planning an Exadata and ZFS Upgrade

- Patch Release Cycle

Quarterly Full Stack Download

Patching Tools and Processes

- OPatch
- patchmgr
- OPlan

Oracle Patch Types

- Patch Set Updates
- Critical Patch Updates and Security Patch Updates
- Oracle Patching Standard
- One-Off Patches

Exadata High Availability Upgrades

Reviewing Settings with Exachk

Exadata Full Stack Upgrade

- Exadata Upgrade Path
- Downloading Patches for Exadata and ZFS
- Upgrading the Cell Nodes
- Updating the Compute Nodes
- Updating InfiniBand Switches
- Updating Grid Home
- Upgrading Ethernet Switches
- Upgrading the KVM Switch
- Upgrading PDUs

ZFS Upgrade

- ZFSSA Configuration and Upgrade
- ZFS Update Stage 1
- ZFS Update Stage 2

Table of Contents

Updating ZFS BIOS

Summary

Chapter 12 ZFS Storage Appliance for Exadata

ZFS Family Line

Increased Storage Capacity

Reclaiming Resources and Space from DBFS

Information Lifecycle Management

ZFSSA Browser User Interface

Creating NFS Shares

Preparing Exadata for Direct NFS

Configuring and Mounting the NFS Share

Snapshots

Clones

Snapshots and Clones with Data Guard

Best-Practice Settings on ZFS Share

Other Industry Use Cases

Learning on the Simulator

Summary

Chapter 13 Exadata Performance Tuning

Oracle Performance Tuning

Systematic Oracle Performance Tuning

Oracle Performance Troubleshooting

Application Design for Exadata

Database Design for Exadata

Storage Indexes

Offloading

Exadata Smart Flash Cache and Indexes

Index Design for New Applications

Table of Contents

Indexing Strategy for Existing Applications

Choosing Compression Levels

SQL Tuning for Exadata

Exadata RAC Tuning

Global Cache Basics

RAC Tuning Principles

Cluster Overhead

Reducing Global Cache Latency

LMS Latency

Balancing an Exadata RAC Database

Balancing Workloads with IORM and DBRM

Optimizing Exadata I/O

Leveraging Flash More Effectively

Configuring the Write-Back Facility

Configuring ASM

Changing the Block Size

Summary

Chapter 14 Database Consolidation on Exadata

Database Consolidation Models

Exadata Consolidation Planning

Grouping Applications

Server Pools

Chargeback

Evaluating Sizing Requirements

Setting Up Exadata for Consolidation

Storage and I/O Settings

Memory Settings

CPU Settings

Table of Contents

Isolation Management

Fault Isolation in Database Consolidation

Fault Isolation in Schema Consolidation

Operational Isolation in Database Consolidation

Operational Isolation in Schema Consolidation

Resource Isolation in Database Consolidation

Resource Isolation in Schema Consolidation

Security Isolation in Database Consolidation

Security Isolation in Schema Consolidation

12c Pluggable Database

Summary

Chapter 15 Exadata Smart Flash Cache in Depth

Solid-State Disk Technology

Limitations of Disk Technology

The Rise of Solid-State Flash Disks

Flash SSD Architecture and Performance

The Oracle Database Flash Cache

Exadata Flash Hardware

Exadata Smart Flash Cache

Exadata Smart Flash Cache Architecture

What the Exadata Smart Flash Cache Stores

Flash Cache Compression

CELL_FLASH_CACHE Storage Clause

Flash Cache KEEP Expiration

Monitoring Exadata Smart Flash Cache

Exadata Smart Flash Cache Performance

Exadata Smart Flash Logging

Controlling and Monitoring Smart Flash Logging

Testing Exadata Smart Flash Logging

Table of Contents

- Smart Flash Cache WriteBack
  - Data File Write I/O Bottlenecks
  - Write-Back Cache Architecture
  - Enabling and Disabling the Write-Back Cache
  - Write-Back Cache Performance
- Summary

Chapter 16 Advanced Exadata Flash Configuration

- Using Flash as Grid Disks
  - Grid Disks, Cell Disks, and the Flash Cache
  - Creating a Flash-Based ASM Disk Group
- Flash Tablespace versus Flash Cache
  - Index Fetch Performance
  - Scan Performance
  - Creating a Flash Temporary Tablespace
  - Using Flash for Redo Logs
- Storage Tiering Solutions
  - Using Partitions to Tier Data
  - 12c ILM and ADO
- Summary

Chapter 17 Exadata Tools and Utilities

- Exadata Diagnostic Tools
  - SunDiag
  - Exachk: Exadata Health Check
- InfiniBand Network Diagnostic Tools
  - Verifying InfiniBand Topology
  - infinicheck
- Other Useful Exadata Commands
  - imageinfo and imagehistory

Table of Contents

InfiniBand NetworkRelated Commands

Monitoring Exadata Storage Cells

Dell Software Tools for Exadata

Monitoring the Cell with Enterprise Manager

Summary

Index