Oracle Secure Backup: Best Practices for Oracle Exadata and Oracle Database

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May Yuan             Director - Application and Infrastructure Architecture, Oracle
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Program Agenda

• **Oracle Secure Backup (OSB) – Overview**
• **Exadata – The Consolidation Platform**
• **OSB Deployments in Exadata Environments**
  – Customer Snapshots
  – Oracle IT – Beehive and OnDemand
• **Summary**
Oracle Secure Backup (OSB)
Centralized Tape Backup Management

Protects Entire IT Environment

- Oracle Database 11g Release 2 to Oracle9i
- 25 – 40% faster tape backup
- MySQL 3.6
- 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

RMAN – Oracle Recovery Manager, MEB – MySQL Enterprise Backup, SBT – Oracle’s API for integration with media managers
Centralized Tape Backup Management
Oracle Secure Backup

Client / Server Architecture

- Data protection for heterogeneous, distributed servers managed from a central console, Administrative Server
- Media servers may be direct or SAN-attached to tape devices
- OSB communicates directly with the client host to backup mounted file systems and storage
- Oracle and MySQL databases may be located on any host within the backup domain as supported by the database
File System Protection
UNIX / Linux / Windows / NAS Devices

- File system backup / restore management
  - EM Grid Control 10.2.0.5, EM Database Control 11.2.0.1, OSB web tool or unified command line (obtool)
- Recurring backup schedule or “Backup Now”
  - Full, incremental, and offsite backup levels
- Backup / restore of Network Attached Storage (NAS) devices using Network Data Management Protocol (NDMP)
- Tree-style catalog browsing for restoration to original or alternate location
- Automatic recall of tapes located offsite to perform the restore operation
- Refer to Certifications on My Oracle Support for listing supported platforms, operating systems and NAS devices
Oracle Environments
File System Backup Methods Vary

**OSB Backs Up the Mounted File Systems:**

**Exalogic**
- OSB client and/or Administrative Server
- Oracle Secure Backup is installed on the Exalogic servers

**SPARC SuperCluster**
- OSB client and/or Administrative Server
- Oracle Secure Backup is installed on each compute node

**UNIX / Linux / Windows Hosts**
- OSB client, media and/or Administrative Server
- Oracle Secure Backup is installed on each host within the domain

**OSB Backs NAS Devices using NDMP:**

**Sun ZFS Storage Appliance**
- OSB client and/or media server
- Oracle Secure Backup supports the NDMP “dump” or “zfs” backup types

**Pillar Axiom 600**
- OSB client and/or media server
- Oracle Secure Backup supports NDMP “dump” backup type
Oracle Database Protection

OSB is Tightly Integrated with Recovery Manager (RMAN)

- Performance optimizations achieving 25 – 40% faster backup directly to tape than comparable products
  - Unused block compression
  - Undo backup compression
  - Optimized buffer allocation between RMAN and OSB
- Encrypted backups using either RMAN or OSB encryption capabilities
- Tape vaulting optimizations with OSB and RMAN
  - RMAN restore database preview identifies offsite backup tapes
  - RMAN restore database preview recall initiates OSB recall of tapes for restoration
- Oracle database backup / recovery management
  - Utilize RMAN command line or Oracle EM (Database or Grid Control) restoring to original or alternate location

OSB differentiator
Oracle Database Environments
OSB and RMAN – Backup Method is Same

- RMAN / OSB integration via SBT interface is the same regardless of the hardware infrastructure
- Oracle Secure Backup is installed on each server participating in the backup
  - Exadata and Oracle Database Appliance are backed up to over the network
  - UNIX / Linux / Windows database servers may be backed up locally attached tape devices or over the network

UNIX / Linux / Windows host(s) as Oracle database server(s)

Oracle Database Appliance

Exadata
Enterprise-Class Features
Oracle Secure Backup Delivers….

Comprehensive media lifecycle management
- Tapes managed from first write to reuse per user-defined policies
- Automates tape duplication and vaulting

Backup encryption and key management
- Leverages host-based or tape drive (LTO or T10000) encryption
- Keys generated and managed per user-defined policies

Advanced tape device configurations
- Dynamic drive sharing between multiple media servers
- Server-less tape duplication
# Broad Tape Device Support

Physical and Virtual Devices

<table>
<thead>
<tr>
<th>ADIC</th>
<th>Copan Systems</th>
<th>Data Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell</td>
<td>EMC</td>
<td>FalconStor</td>
</tr>
<tr>
<td>HP</td>
<td>IBM</td>
<td>Overland Storage</td>
</tr>
<tr>
<td>Quantum</td>
<td>Qualstar</td>
<td>Sepaton</td>
</tr>
<tr>
<td>Sony</td>
<td>Spectra Logic</td>
<td>StorageTek</td>
</tr>
</tbody>
</table>

For a list of supported devices refer to:
IT Cost Savings…75%+
Migration to OSB

<table>
<thead>
<tr>
<th>Description</th>
<th>Oracle Secure Backup</th>
<th>Competitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tape drives</td>
<td>$21,000</td>
<td>$21,000</td>
</tr>
<tr>
<td>Shared tape drives</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Exadata - Full rack</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>UNIX media server</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Linux media servers</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Linux / Windows / Sol x-86 clients</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Database / Application pack - UNIX</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Database / Application pack - Linux</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Vaulting (1 server / 4 drives)</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>Vaulting - Additional drives</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>$21,000</strong></td>
<td><strong>$106,415</strong></td>
</tr>
</tbody>
</table>

Oracle Secure Backup is licensed at $3500 per tape drive.
Imagine how much in annual maintenance costs you’ll save!!!
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Data Protection
In Consolidated Environments

Create Plan
- Group applications with similar RTO / RPO applications

Do the Math
- Identify IO constraints

Schedule Accordingly
- Stagger backups

Consolidation Best Practices
Oracle Integrated Backup to Disk and/or Tape

Multi-tiered Backup Strategy

Fast Recovery Area

D2D2T

Backup Recovery Area;

Backup to Tape

Backup Backupset;

RMAN Disk Backup

RMAN can restore seamlessly from disk or tape!
Exadata Disk-To-Disk-To-Tape (D2D2T) Strategy

RMAN Backup from ZFSSA to Tape via OSB

Oracle Exadata Database Machine

OSB Administrative Server

OSB Media Server(s)

Sun ZFS Storage Appliance (ZFSSA)

StorageTek Tape Library

Infiniband QDR Network

Fibre Channel

RMAN Backup to disk

RMAN Backup to tape via OSB

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OSB Policy Based Media Lifecycle Management
Groups Backups with Similar Media Policies

- OSB manages tapes from first write to reuse based on user-defined media families, duplication and rotation policies.

**Media Family:**
Tape pool foundation, establishes retention

**Tape Reuse:**
Expired tapes are automatically reused as needed when located with a tape device.

**Duplication Policy:**
Automates duplication of tapes using the same or differing retention / rotations.

**Rotation Policy:**
Automates tape rotation between two or more sites.
Complete Oracle Integrated Solution
Oracle-Built, Supported and MAA Validated

- Performance results:
  - Backup rate: 8.6 TB/hr
    (179MB/sec per tape drive)
  - Restore rate: 7.8 TB/hr
    (162MB/sec per tape drive)

For more information, refer to the Maximum Availability Architecture (MAA) white paper:

Sizing the Backup Servers

- Media servers - workload is focused on data movement, not processing power
- Assume about 2GB/s throughput via IB (TCP/IP tunneled) per media server
- Administrative Server requires enough disk space for catalog growth

What if multiple databases are consolidated on Exadata?
- Bandwidth, throughput and capacity remain the same whether one or more databases – No effect on media server sizing

For more information on sizing an Exadata tape backup environment, refer to:
Media Considerations

How Many Tapes Will be Required?

• Native tape capacity varies by tape drive
  – Advertised compression capability about 2:1
  – Real world ratios about 1.5:1 or less – depends on compressibility of data

• Considerations which effect tape drive compression:
  – Encrypted backups – can’t be compressed
  – Compressed data – won’t benefit from tape drive compression
    • Backups compressed on the host (e.g. RMAN compressed backup)
    • Compressed production data which remains compressed in the backup, for example:
      – Exadata Hybrid Columnar Compression (HCC)
      – Table or tablespace compression - Advanced Compression Option (ACO)
Performance Tuning
Oracle Database - OSB Tape Environment

- RMAN channel allocation:
  - One channel per tape drive
  - Spread RMAN channels across all / multiple nodes
- Set the optimal OSB blocking factor for the tape drive type
- OSB maximum blocking factor > than highest blocking factor setting

<table>
<thead>
<tr>
<th>Drive Type</th>
<th>Blocking Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTO-4</td>
<td>256</td>
</tr>
<tr>
<td>LTO-5</td>
<td>1024</td>
</tr>
<tr>
<td>T10000B</td>
<td>1024</td>
</tr>
<tr>
<td>T10000C</td>
<td>2048</td>
</tr>
</tbody>
</table>
Schedule Accordingly

Effective Management of Backup Resources

• Stagger backups
  – OSB has calendar based scheduling for easily creating one-time or repeating backups

• Concurrent backups – assign to different tape drives
  – OSB provides comprehensive policies allowing users to control use of all or select tape drives and more:
    • Backup schedules for file system backups
    • Database Backup Storage Selectors for database backups
Policy Based Storage Management

Critical in Consolidated Environments

**DATABASE BACKUP STORAGE SELECTORS**

- Communicates storage parameter settings between RMAN and Oracle Secure Backup
- Controls which media family and device(s) are used based on backup type and/or copy number
- Optionally, restrict these backups to specific tape drives
- One or more backup storage selectors may be configured per backup domain or database

<table>
<thead>
<tr>
<th>Name</th>
<th>Content: all full incr archive log auto backup</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Database(s): Use * for all database names</td>
</tr>
<tr>
<td></td>
<td>Database ID(s): Use * for all database ids</td>
</tr>
<tr>
<td></td>
<td>Host: dcocksey-lap2</td>
</tr>
<tr>
<td></td>
<td>Media family: Local_Tapes</td>
</tr>
<tr>
<td></td>
<td>Restrictions</td>
</tr>
<tr>
<td></td>
<td>Copy number</td>
</tr>
<tr>
<td></td>
<td>Resource wait time</td>
</tr>
<tr>
<td></td>
<td>Encryption</td>
</tr>
<tr>
<td></td>
<td>(Apply) OK Cancel</td>
</tr>
</tbody>
</table>
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Safaricom

Leading Communications Provider in Kenya

• Safaricom provides converged communication solutions addressing evolving voice, video and data requirements:
  – Enterprise mobility, fixed data connectivity, Telepresence
  – Wholesale bandwidth capacity solutions for national, regional and international market segments

• The Safaricom managed services division provides tailor-made solutions for SMB and the enterprise such as:
  – Cloud computing, domain / hosted services, conferencing and more

• Known for customer service and community involvement, Safaricom is the leading provider of consumer mobile, high-speed internet in the region
Safaricom

Uses Exadata for Critical Databases

• Safaricom leverages Exadata for its critical databases requiring high availability and optimal performance such as:
  – Business Intelligence (BI) data warehouse system for reporting and analytics – 15TB database
  – Fraud management database along with other OLTP high-priority systems

• Exadata delivers great performance with built-in storage intelligence which is ideal for Safaricom systems
  – Exadata uses the best available storage (Flash to SATA) based on how frequently the data is accessed
Exadata Data Protection

Safaricom Chose an Oracle Solution

• Exadata data protection strategy includes a complete Oracle solution:
  – Oracle Secure Backup
  – Sun ZFS Storage Appliance
  – StorageTek SL3000 with 6 LTO-5 tape drives

• Safaricom leverages a D2D2T backup strategy:
  – Exadata backup to disk on the ZFSSA
  – Backup the RMAN disk backup to tape using OSB
    • RMAN command BACKUP BACKUPSET;
Safaricom
Exadata Backup Solution: OSB, ZFSSA, StorageTek
Oracle Secure Backup

Configuration

• Oracle Secure Backup 10.3.0.3
  – Administrative and Media Server – Sun Fire x4170
    • Zoned to manage robot and 2 of the 6 tape drives
    • One six-core processor and 16GB of RAM, two 4Gb/s FC ports and two IB ports
  – Media Server – Sun Fire X4270
    • Zoned for access to 4 of 6 tape drives
    • Two six-core processor and 24GB of RAM, four 4Gb/s FC ports and two IB ports

• Network interfaces to OSB media servers are bonded for high availability

• Backup of the OSB catalog to tape daily
Backup Performance to Tape
OSB Delivers…

• Tape backup performance using OSB is very good
  – Backup to tape of the 15TB BI database takes about 6 hours
    • Tremendous improvement over the previous solution which took about 5 days

• Backup architecture designed for optimal performance
  – Infiniband (IB) connectivity from Exadata to the OSB media servers and ZFSSA
  – OSB media servers are FC connected to the StorageTek SL3000

• One RMAN channel allocated per tape drive
  – The six RMAN channels are spread across four RAC nodes on the Exadata
“Safaricom chose a complete Oracle backup solution (OSB, ZFSSA and StorageTek) for an integrated disk and tape data protection strategy for Exadata.”

Donald Twesiga
Head of Information Technology, Safaricom
Japanese Education Business – OSB Customer
Exadata – Backup Infrastructure Planning

Backup and Recovery Requirements
- Recovery window = 24 hours
- Full / Incremental backup strategy
  - Full backup window = 12 hours (Sunday)
  - Daily incremental backup window =1 hour (Mon-Sat)

Sizing Assumptions
- Amount of backup data = 15TB (non-compressed)
- Daily change rate of 5%
- LTO-4 tape drive = 110MB/s

Doing the Math....

<table>
<thead>
<tr>
<th>Incremental backup size</th>
<th>15TB * 5% = .75TB</th>
</tr>
</thead>
</table>

| Required incremental backup performance: |
| .75TB ÷ 1 hour = 218MB/sec |
| 218MB/sec ÷ 110MB/sec = 1.98 tape drives |

| Required full backup performance: |
| 15TB ÷ 12 hours = 340MB/sec |
| 364MB/sec ÷ 110MB/sec = 3.31 tape drives |

| Weekly number of tape cartridges needed: |
| .75TB * 6 days = 4.5TB ÷ 800GB = 6 LTO-4 |
| 15TB * 1 day = 15TB ÷ 800GB = 19 LTO-4 |
| Weekly tapes needed = 19 + 6 + 1 extra = 26 |

| Tapes required for full retention cycle: |
| 26 tapes / week * 5 weeks = 130 tapes |

Oracle Exadata
Database Machine
½ Rack
Japanese Education Business – Cont’d
Exadata Backup Solution – OSB and StorageTek

Oracle Secure Backup
Administrative and Media Server

Sun Fire X4270 M2
Includes:
1 – QDR Infiniband HCA
2 – 8Gb Dual FC HBAs

Exadata – ½ Rack

Fibre Channel Switch - 16 ports

StorageTek SL500

Robot
LTO4 drive
LTO4 drive
LTO4 drive
LTO4 drive

• Performance results achieved using four LTO-4 tape drives:
  – Production database backup: 2.56 TB/hr (178 MB/sec per tape drive)

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Large Agricultural Company
Exadata Backup Solution – OSB, ZFFSA, SL3000

Data protection strategy for mission-critical labs data

Oracle 7420 SINGLE HEAD
ZFS Storage Appliance
7420 Head - 2x8-Core, 128GB DRAM
2x 512GB Readzilla SSDs
2x QDR InfiniBand HCAs
2x DUAL PORT FC8 Emulex HBAs
2x 10Gb Enet HCAs

Oracle Secure Backup
Administrative Svrs - X4170M2
2x Media Svrs - X4270M2
2x6-Core Intel X6670, 16GB
2x DUAL PORT FC8 Emulex HBAs
Dual Port InfiniBand HCAs

Exadata V2-2
FOUR FRAMES

Brocade 5100
40 Port FC Switch

SL3000 Library
8 x LT05 FC8 Tape Drives
BASE + CARTRIDGE EXPANSION
838 Tape Slots & 24 Drive Bays

Meeting RTO of 8 Hours –
FULL RESTORES & INCREMENTALS must complete in < 7 Hours
FULL & INCREMENTALS RESTORES from Single Disk

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Large Agricultural Customer – Cont’d
OSB Tape Environment

OSB policy-based management in action:

- Backup Schedule
  - Weekly, Level 0
  - Daily, Level 1
- RMAN backup from Exadata to ZFSSA
- RMAN backup from ZFSSA disk to tape via OSB

Tape Storage MANAGEMENT
Year 1 – 8 x LTO5 Drives, 580 SLOT Library

Create All Tape Copies Post Disk Backup
2 TAPE COPIES of PRODUCTION Data (Library & Offsite)
2nd Tape Copy of PROD via OSB Tape to Tape Copy

Retain PROD Tape Copies 60 Days (8 Cycles) in Library & Vault
Retain TEST,DEV & PRODSPT Tape Copies 30 Days (4 Cycles) in Vault

Recycle Tapes weekly
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Oracle Beehive Technology
Collaboration Suite Utilized by 100,000+ Oracle Employees

• Over 100k Oracle employees, can do a lot of communicating per day:

  - Email: 2.7 million emails/day
  - Calendar: 100 thousand events/day
  - File Sharing: 93 thousand docs read/day
  - Chat: 2.2 million IM messages/day
Oracle Beehive IT
Manages the Beehive Infrastructure at Oracle

• Oracle Beehive IT has been in production with Exadata since V1 (2009), upgraded to Exadata X2-2, 9 full racks
  – 1,500 average tps, 24 x 7
  – Over 5,000 peak tps!

• High availability of the Beehive database is critical!
  – Leverage a Maximum Availability Architecture using Oracle Data Guard, Oracle Recovery Manager (RMAN), Oracle Secure Backup (OSB), Oracle Real Application Clusters (RAC) and Oracle Automatic Storage Management (ASM)

• Exadata storage sized to accommodate:
  – Beehive Database = 140TB (100TB user data + 40TB SecureFiles)
  – About 400TB for mirrors and disk backup (Fast Recovery Area)
  – Another 100TB allocated for growth
Beehive Exadata Configuration

25-node Application Tier

16-node Database Cluster
98 Exadata Storage Servers
800 TB disk capacity
No flash
Disk & tape backups
Beehive Disk Backup

Fast Recovery Area (FRA)

• The Fast Recovery Area resides on Exadata storage for maximum performance and high availability
• Beehive SLA requires ability to recover from disk any point in time within 7 days
• The FRA is sized for recovery from disk for 7 days:
  – Includes one full image copy backup, archived logs and incremental backups
  – `db_recovery_file_dest_size` 220,000G
• Incremental forever strategy (after initial full)
  – Daily incremental backup of about 1 – 1.2TB
  – Daily roll-forward of the full database bringing it current to “n – 7 days”
Beehive Tape Backup

Oracle Secure Backup

- Beehive IT has counted on Oracle Secure Backup (OSB) for over 5 years to deliver reliable tape backups

- Tape backup schedule:
  - Weekly full backup of the FRA
  - Daily backup of archived logs

- Tape drives used depends on the backup:
  - Weekly full uses 12 tape drives
  - Daily archived logs use 8 tape drives

- Weekly file system backup of local files on database and mid-tier servers to tape
Beehive Tape Backup Infrastructure:

- **Oracle Secure Backup**
  - One Administrative Server
  - Four media servers

- **StorageTek SL3000 with 12 T10000C tape drives**
  - StorageTek ACSLS 8.0 with SCSI Media Changer (SMC) logical library configuration

- **Oracle Key Manager (OKM) manages the encryption keys**
  - Backups encrypted using StorageTek T10000C encryption
    - The tape drive compresses then encrypts the backups
Beehive IT – Key Takeaways

Oracle Maximum Availability Architecture (MAA)

- Over 100,000 Oracle employees depend on the Beehive collaboration suite – Downtime is NOT an option!
  - PS...this includes Larry Ellison

- Beehive IT counts on the Oracle MAA to meet our SLAs

- Exadata delivers the performance and built-in high availability we demand

- Our Exadata backup and recovery solution is a key component of our MAA strategy and has been validated by the MAA development team:
  - RMAN disk backup to the Fast Recovery Area on Exadata storage
  - Backup of the FRA to tape using Oracle Secure Backup

We chose an Oracle MAA validated backup solution for Exadata!
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  – The Consolidation Platform

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Summing it Up.....

Oracle Secure Backup – Key Differentiators

Increased Return on Investment (ROI):

- Single technical support resource from hardware to software
- High-performance, secure tape backup – Exclusive optimizations
- Fully validated component of the Oracle Maximum Availability Architecture (MAA)
- Substantial cost savings – about 75% less than others

Who Better to Backup Oracle than Oracle?
Resources

- OTN HA Portal:
  http://www.oracle.com/goto/availability

- Maximum Availability Architecture (MAA):
  http://www.oracle.com/goto/maa

- MAA Blogs:
  http://blogs.oracle.com/maa

- Exadata on OTN:

- Oracle HA Customer Success Stories on OTN:
Key HA Sessions, Demos, Labs by Oracle Development

**Monday, 3 Oct – Moscone South ***
- **11:00a** Auto Detect, Prevent and Repair Data Corruptions, Rm 102
- **12:30p** Future of Oracle Exadata, Rm 104
- **12:30p** RMAN: Not Just for Backups Anymore, Rm 304
- **2:00p** Extreme Data Management, Moscone North Hall D
- **5:00p** Oracle High-Availability System Overview, Rm 104
- **5:00p** GoldenGate Product Update and Strategy, Intercontinental-Sutter

**Tuesday, 4 Oct – Moscone South ***
- **10:15a** Oracle Secure Backup - Best practices, Rm 304
- **11:45a** Oracle Exadata Technical Deep Dive, Rm 104
- **3:30p** RMAN & Data Guard: Seven Cool Tips from Oracle, Rm 304
- **3:30p** Consolidation on Oracle Exadata, Rm 103

**Wednesday, 5 Oct – Moscone South ***
- **10:15a** Oracle Active Data Guard - Lessons Learned, Rm 102
- **1:15p** Data Guard for Planned Maintenance, Rm 102
- **1:15p** Understanding Oracle RAC Internals, Rm 103
- **1:15p** Clone Oracle with CloneDB and Direct NFS, Rm 270

**Thursday, 6 Oct – Moscone South ***
- **9:00a** Exadata Backup and Recovery, Rm 304
- **10:30a** Deduplication and Compression for Backups, Rm 304
- **12:00p** Data Guard Switchover / Failover, Rm 103
- **3:00p** Configure, Size, Monitor Fast Recovery Area, Rm 304
- **3:00p** PeopleSoft with Active Data Guard, Moscone West 2022

**Demos Moscone South DEMOGrounds**
- **Mon 10:00a - 5:30p** Tue 9:45a - 6:00p Wed 9:45a - 4:00p
  - Maximum Availability Architecture (MAA)
  - Active Data Guard
  - Recovery Manager & Flashback
  - Real Application Clusters
  - Exadata
  - Oracle Secure Backup
  - GoldenGate
  - ASM

**Hands-on Labs Marriott Marquis**, Salon 14 / 15
- **Monday, Oct 3, 5:00 pm - 6:00 pm** Oracle Active Data Guard
- **Tuesday, Oct 4, 10:15 am - 11:15 am** Oracle Active Data Guard

*All session rooms at Moscone South unless otherwise noted
Q&A
Hardware and Software

Engineered to Work Together