Best Practices for Oracle Exadata Cloud Deployments
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Agenda

- Oracle Exadata Cloud Overview
- Selecting the Cloud MAA Architecture
- Oracle Exadata Cloud Configuration Best Practices
- Cloud MAA Life Cycle Operations: Tips and Pointers
Best Practices for Oracle Exadata Cloud Deployments

Oracle Exadata Cloud Overview
Oracle Exadata Advantage

**Ideal Database Hardware**
Leading edge enterprise-grade components for maximum performance and value

**Smart System Software**
Database-aware algorithms vastly improve the effectiveness of ALL workloads

**Automation**
Automated infrastructure integrated with Oracle Autonomous Database

Best Database Platform: Identical On-Premises and Cloud
Oracle Exadata Cloud Offerings

**Core Exadata Platform**

- Flexible Subscription Model
- Database PaaS Services
- Secure Virtual Networks
- Cloud Security and Hardening
- Oracle-Managed Exadata Infrastructure

**Exadata Cloud at Customer**
- In Data Center of Customer’s Choice

**Exadata Public Cloud Service**
- In Oracle Public Cloud Data Centers
Gen 2 Exadata Cloud at Customer

- Gen 2 public cloud manages Gen 2 Exadata Cloud at Customer
  - Eliminates additional control plane rack in customer data center
  - Simpler, lower cost, faster time to value

- New Exadata Cloud at Customer X8 hardware
  - Faster CPUs, more cores, more storage than ExaCC X7

- Simpler connectivity to customer network
  - Adapts to customer networking standards and requirements

- Now supports Oracle Database 19c
  - Long-term support for the 12.2 family

- Ready for Autonomous Database at Customer

Runs the best database on the best platform in the best Cloud in your data center
Best Practices for Oracle Exadata Cloud Deployments

Selecting the Right Maximum Availability Architecture for Exadata Cloud
What Are Your Service Level Agreements and Business Factors?

Impact of Downtime
Cost of downtime
- Business/Market Share
- Application or Database
- Consolidated set of applications or databases

Downtime (RTO)
How much downtime before serious business impact?
- For planned maintenance?
- for Local Failures?
- for Disasters and Corruptions?

Data Loss (RPO)
How much data can I lose before the business suffers irreparable damage?

MAA Architecture
Pick the architecture that fits your needs.
- Any environmental restraints?
- Application needs to be close to the database
- Specific region or location
- Network latency and bandwidth requirements
Oracle Maximum Availability Architecture (MAA) Solution Options

**BRONZE**
- Dev, Test, Prod
- Single Instance with Restart
- Online Maintenance
- Validated Backup/Restore

**SILVER**
- Prod/Departmental
- Bronze +
  - Database HA
  - Active/Active Clustering
  - Application Continuity

**GOLD**
- Mission Critical
- Silver +
  - Physical Replication
  - Comprehensive Data Protection

**PLATINUM**
- Extreme Critical
- Gold +
  - Logical Active/Active Replication
  - Advanced HA Options

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BRONZE

Dev, Test, Prod - Single Instance or Multitenant Database with Backups

- HA infrastructure for storage and network
- Single Instance with Clusterware HA Management
- MAA cloud backup/restore
  - Cloud object storage backups with copy across AD for public cloud
  - ZDLRA with incremental forever and near zero RPO for Exadata Cloud@Customer
- Multitenant Database/Resource Mgmt with PDB features
- Online Maintenance
- Some corruption protection
- Flashback technologies

Outage Matrix

<table>
<thead>
<tr>
<th>Unplanned Outage</th>
<th>RTO / RPO Service Level Objectives (f1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recoverable node or instance failure</td>
<td>Minutes (f2)</td>
</tr>
<tr>
<td>Disasters: corruptions and site failures</td>
<td>Hours to days. RPO since last backup or near zero with ZDLRA</td>
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<th>Planned Maintenance</th>
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<tr>
<td>Software/hardware updates</td>
</tr>
<tr>
<td>Major database upgrade</td>
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f1: RPO=0 unless explicitly specified
f2: Exadata systems has RAC but Bronze Exadata configuration with Single Instance database running with Oracle Clusterware has highest consolidation density to reduce costs.
Outage Matrix

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Planned Maintenance

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<td>Minutes to hour</td>
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f1: RPO=0 unless explicitly specified
f2: To achieve zero downtime or lowest impact, apply application checklist best practices
Mission Critical

Silver +
- Active Data Guard
- Comprehensive Data Protection

MAA Architecture:
- Minimum one standby either across AD or region.
- ExaCC/ExaCS primary in one data center (or AD) replicated to a standby ExaCC/ExaCS in another data center.
- Local backups on both sites

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<td>Single digit seconds (f2)</td>
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<tr>
<td>Disasters: corruptions and site failures</td>
<td>Seconds to 2 minutes. RPO zero or seconds</td>
</tr>
</tbody>
</table>

Planned Maintenance

| Software/Hardware updates                  | Zero (f2)                             |
| Major database upgrade                     | Less than 30 seconds                  |

f1: RPO=0 unless explicitly specified
f2: To achieve zero downtime or lowest impact, apply application checklist best practices
**Gold +**
- GoldenGate Active/Active Replication
- Optional Editions Based Redefinition

**MAA Architecture:**
- Each GoldenGate “primary” replica protected by Exadata, RAC and Active Data Guard
- ExaCC/ExaCS primary in one data center (or AD) replicated to another primary ExaCC/ExaCS in remote data center (or AD)
- Oracle GG & Edition-based Redefinition (EBR) for zero downtime application upgrade
- Local/cloud backups on both sites
- To achieve zero downtime, custom failover to available GG replica required

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**Outage Matrix**

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<tr>
<td>Recoverable node or instance failure</td>
<td>Zero or single digit seconds (f2/f3)</td>
</tr>
<tr>
<td>Disasters including corruptions and site failures</td>
<td>Zero (f3)</td>
</tr>
</tbody>
</table>

**Planned Maintenance**
- Most common software/hardware updates Zero (f2)
- Major database upgrade, application upgrade Zero (f3)

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f1: RPO=0 unless explicitly specified
f2: To achieve zero downtime or lowest impact, apply application checklist best practices
f3: Application failover is custom or with Global Data Services
MAA Database Deployment in the Cloud

- Simple UI / CLI / REST interfaces being configured for MAA topologies
- Databases are provisioned with MAA parameter configurations
- MAA made easy in the Cloud
  - Oracle Cloud Infrastructure (or) Cloud at Customer

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1. **BRONZE**
   - Single Instance
   - DB Backup Service

2. **SILVER (HA)**
   - RAC
   - DB Backup Service

3. **GOLD (DR)**
   - Primary
   - Region #1
   - Standby
   - Region #2

4. **PLATINUM (HA)**
   - Primary
   - AD #1
   - FSFO
   - GG replication
   - AD #2
   - Primary
   - Standby
   - FSFO
Best Practices for Oracle Exadata Cloud Deployments

Oracle Exadata Cloud Configuration Best Practices
Oracle Exadata Cloud Best Practices –

In the Cloud, ExaCS and ExaCC are Deployed with Exadata and MAA Best Practices

- Exadata Cloud deployment has built-in Exadata and MAA best practices
  - Exachk –profile exatier1 is near 100% after deployment today

- Refer to Oracle Exadata Database Machine exachk or HealthCheck (Doc ID 1070954.1)
  - Exachk –profile exatier1 for initial deployment and before/after planned maintenance
  - Exachk full checks monthly – comprehensive checks including lower priority alerts/warnings
Best Practices for Oracle Exadata Cloud Deployments

Cloud MAA Life Cycle Operations: Tips and Pointers
Cloud Tip 1: Sizing, Planning and Deployment

“Avoid Outages and Poor Performance”

Understand your requirements
1. Database CPU processing
2. Database Memory*
3. Database Storage capacity and throughput*

Determine all databases to be consolidated based on requirements

Pick the correct Exadata shape
Including Test/Dev Environments

Work with Oracle Sales or Pre-Sales Consultant

*No oversubscription of memory and storage capacity
*Performance impact when oversubscribing CPU and storage throughput limits
Cloud Tip 2: Cloud Database Creation and Deployment Success Factors

Creating Cloud databases with Exadata and MAA templates
1. Install latest cloud software which includes dynamic hugepage adjustments
2. Use only cloud console or cloud APIs to create databases to leverage Exadata MAA database defaults
3. Change memory and performance settings for the application
4. Monitor hugepages and memory to accommodate all database and ASM SGAs for each node

AVOID!!!
1. DBCA or your custom create database scripts
2. Inherent your existing initialization parameters (with undoc parameters, arbitrary tracing and settings that you don’t even remember what is used for)
3. No ACFS for database, backup, DB/GI software, diagnostic_dest, ORACLE_BASE, audit_file_dest
Cloud Tip 3: Use ZDM for Database Migration to Cloud

Tip 3a: Use ZDM for automated physical migration

- Backup/Restore for Instantiation
- Encryption conversion can happen in cloud without impacting on-premise
- Data Guard switchover reduces downtime
- Refer to www.oracle.com/goto/zdm for demo and documentation
- Refer to MAA practices for ZDM MAA MOS 2562063.1
- Evaluate network bandwidth prior to migration with MOS 2064368.1

Tip 3b: Use MV2OCI for automated logical migration

- MV2OCI and MV2ADB uses Data Pump to instantiation and to re-optimize data
  - Complete orchestration, prechecks and cloudify
  - Encryption conversion will happen in the cloud without impacting on-premise
  - ZDM integration coming soon
- GoldenGate solution reduces downtime
  - [Oracle Database Migration with an Oracle GoldenGate Hub Configuration](#)
  - Future ZDM solution with GoldenGate.
  - GoldenGate restrictions still applicable

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Zero Downtime Migration

Workflow

- When ready, Data Guard Switchover with seconds to minutes of downtime
- Database is registered as new cloud database so cloud life cycle operations can be enabled
- Application from on-premise or in the cloud connects to new Primary in the cloud
Cloud Tip 4: Prepare for Cloud Infrastructure Software Updates

“Oracle manages infrastructure software updates”

- Exadata Network and Storage
  - Zero database or minimum application impact
  - During window, reduce maximum IO throughput

- Exadata Dom0 updates should occur quarterly
  - Zero database downtime with RAC Rolling
    - Service drain is automatic
  - Zero application downtime if Continuous Availability - Application Checklist for Continuous Service for MAA Solutions and MOS 2385790.1 practices
  - During window, prepare for reduced DB compute processing
Cloud Tip 5: Prepare for DB Quarterly Software Updates

- Customer is responsible for DB Quarterly Software Updates to maintain stability and security compliance
- Zero database downtime with RAC rolling
- Zero application downtime only if Continuous Availability - Application Checklist for Continuous Service for MAA Solutions is followed. During window, prepare for reduced DB compute processing.

Key Practices for Success

- Prerequisites completed prior to planned maintenance window:
  - Create software plan (target release + one-off, evaluate test/uat, then standby and then primary)
    - dbaascli DATABASE MOVE for primary and standby, out-of-place, apply one-offs beforehand, and simpler fallback.
    - dbaascli PATCH DB if you want to patch subset of nodes or you want to patch a lot of databases on the same OH with one command
  - Download latest tools (dbaascli patch tools apply --patchid LATEST)
  - Create new DB Home using cloud tooling
  - Apply interim patches to new database home, as required
  - Run database move precheck
  - Run exachk –profile exatier1

- During patching:
  - Dbaacli database move -dname <dbname> -home <oracle_home>
  - only run datapatch after all databases in DG environment is patched
Cloud Tip 5b: Prepare for GI Quarterly Software Updates

- Customer is responsible for GI Quarterly Software Updates to maintain stability and security compliance
- Zero database downtime with RAC rolling
- Minimum application downtime only if [Continuous Availability - Application Checklist for Continuous Service for MAA](#) is followed. GI software updates do NOT drain the service today except in the case with Autonomous
- During window, prepare for reduced DB compute processing
- Key Practices for Success
  - Prerequisites completed prior to planned maintenance window:
    - Create software plan with latest cloud doc
    - Download latest tools (dbaascli patch tools apply --patchid LATEST)
    - Run GI patch precheck (dbaascli patch db prereq --patchid <patchid> --dbnames grid)
    - exachk --profile exatier1
  - During patching:
    - `dbaascli patch db prereq --patchid <patchid> --dbnames grid`
    - Patching the Grid infrastructure is a RAC rolling operation which will stop all database instances on a node that at the time it is being patched.
Cloud Tip 6: Prepare for Exadata Quarterly Software Updates

• Customer responsible for Exadata operating system software updates
• **Zero** database downtime with RAC rolling
• **Zero** application downtime only if [Continuous Availability - Application Checklist for Continuous Service for MAA Solutions](#) is followed. Service drain is incorporated
• During window, prepare for reduce DB compute processing
• Key Practices for Success
  • [Updating an Exadata DB System (OS Updates)](#)
  • [How to update the Exadata System Software (DomU) to 19c from 18c on the Exadata Cloud Service in OCI (Doc ID 2521053.1)](#)
  • [How to update the Exadata System Software (DomU) on the Exadata Cloud Service in OCI (19.x to 19.x) (Doc ID 2566035.1)](#)

**WARNING: Avoid customizations since they will need to be removed prior to software update and added back afterwards**
Cloud Tip 7: Use MAA Cloud Backup/Restore Best Practices

- Cloud MAA practices integrated with automatic backup and latest tooling
- Refer to [Oracle Cloud Infrastructure Exadata Backup & Restore Best Practices using Cloud Object Storage](#)
- Use cloud backup APIs and use ZDLRA for Exadata Cloud@Customer
- [Customizing Backup Settings by Using a Generated Configuration File](#)
  - Pick least intrusive backup start time (bkup_daily_time)
  - For cloud object storage, pick the day you want to level 0 backup (bkup_oss_L0_day)
  - All other defaults are good
  - Increase RMAN parallelism (bkup_channels_node=4 default) if current backup/restore rate is not acceptable (e.g. 2.1 TB/hour observed). Disable RMAN compression if database uses a lot of HCC compression
- Periodic restore test is recommended
Backup and Restore Performance Improvements

**Oracle MAA Best Practices for Oracle Cloud Backups**

Backup and Restore Performance Improvements

**Default:**
- **Backup:** 2 TB/hr
- **Restore:** 2.8 TB/hr

**Tuned:**
- **Backup:** 8.31 TB/hr
- **Restore:** 8 TB/hr

---

**Backup Throughput**

Default: 18 TB/hr

**Restore Throughput**

Default: 2 TB/hr

**Tuned:**
- **Backup:** 8.31 TB/hr
- **Restore:** 8 TB/hr
Cloud Tip 8: Leverage Exadata Health Checks and Integrate Monitoring and Alerting

- Real Time Monitoring and Monthly Health Checks keep the Exadata Cloud system healthy and sound
- Oracle Exadata Database Machine exachk or HealthCheck (Doc ID 1070954.1)
  - Execute monthly and address FAILURES and WARNINGS
- Use Enterprise Manager
  - Deploy EM agents in each database server (DomU)
  - Monitor cluster, ASM, and database
  - Refer to Oracle Enterprise Manager for Exadata Cloud, Exadata Health and Resource Utilization Monitoring - Exadata Database Machine KPIs and Exadata Health and Resource Utilization Monitoring - Adaptive Thresholds
- Use Cloud Console to monitor overall state of your cloud targets
Cloud Tip 9: Use Data Guard and GoldenGate for Gold and Platinum MAA

- Data Guard cloud solution
  - Essential for Mission Critical (Gold and Platinum) for Enterprise Database
  - Offload reporting, auto block repair for data corruptions, comprehensive data protection, HA/DR

- Data Guard Cloud Updates
  - ExaCS/ExaCC Gen1: Data Guard full support with cloud console and API
  - ExaCC Gen2 and Hybrid Data Guard: Manual Data Guard setup
  - Primary and Standby are Symmetric
  - DG Cloud functionality includes MAA config, DG role transitions, Monitoring

- GoldenGate cloud solution
  - Essential for Platinum and Zero Downtime Migration and Upgrade
  - New: Part I Getting Started with Oracle GoldenGate on Oracle Cloud Marketplace
  - New: OOW 2019 Presentation: Oracle MAA for Oracle Database, Exadata, and the Cloud
## Data Guard Cloud Support Matrix

<table>
<thead>
<tr>
<th>Data Guard in the cloud</th>
<th>ExaCS</th>
<th>ExaCC Gen1</th>
<th>ExaCC Gen 2</th>
<th>Autonomous DB</th>
<th>Hybrid to BM/VM, ExaCS or ExaCC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Console Deployment</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Planned</td>
<td>Planned</td>
<td>No</td>
</tr>
<tr>
<td><strong>DBaaS API support</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Planned</td>
<td>Planned</td>
<td>No</td>
</tr>
<tr>
<td><strong>Role Transition/Reinstate</strong></td>
<td><strong>Monitoring</strong></td>
<td><strong>Console and dbaascli (no cross region)</strong></td>
<td><strong>Console and dbaascli</strong></td>
<td><strong>Planned</strong></td>
<td><strong>Planned</strong></td>
</tr>
</tbody>
</table>
| **Cloud DG Doc**        | **ExaCS Data Guard Doc** | **ExaCC Gen1 Data Guard Doc** | Use ExaCS Hybrid Paper to set up Data Guard but limited cloud life cycle support | N/A | • OCI BM/VM Hybrid - MAA Whitepaper  
• ExaCC Gen1 - MAA Whitepaper  
• ExaCS & ExaCC Gen 2 - MAA Whitepaper |
Oracle GoldenGate for Exadata Cloud

Oracle GoldenGate is fully supported in Oracle cloud for DBaaS, ExaCS, and ExaCC. Migrating a database using GoldenGate to Autonomous database is possible today. Refer to Oracle GoldenGate Cloud Service: https://docs.oracle.com/en/cloud/paas/goldengate-cloud/index.html

Oracle GoldenGate deployment can use GoldenGate on OCI Marketplace to install and deploy GoldenGate in a separate cloud system resource to offload GoldenGate software maintenance and configuration from source and target Exadata servers. This “GoldenGate Hub” can be used for migration or replication purposes.

Oracle GoldenGate can be deployed and configured on source or target database server on DBaaS, ExaCS and ExaCC. Refer to https://docs.cloud.oracle.com/en-us/iaas/Content/Resources/Assets/whitepapers/oracle-goldengate-microservices-architecture-on-oci.pdf Key points for this type of deployment are the following:

• Use ACFS or DBFS for GoldenGate files
• Install latest GoldenGate software locally on all nodes and ensure the directory is the same in all nodes
• Install Oracle Grid Infrastructure Bundled Agents for GoldenGate
• Use GoldenGate Microservices
• For all GoldenGate license questions, refer to http://aseng-wiki.us.oracle.com/asengwiki/display/GoldenGate/GoldenGate+on+OCI+Marketplace+FAQs
Cloud Tip 10: 19c GI and Database is Strategic

- Database 19c is the most current long term supported release.
  - Refer to Release Schedule of Current Database Releases (Doc ID 742060.1)
  - Supported until 2023 and with extended support until 2026
  - 11.20.4 and 12.1.0.2 support ended. 12.2.01 support ends late 2020. 18c in mid 2021.

- Today
  - All new Exadata Cloud Deployments have 19c Grid Infrastructure
  - All Exadata Cloud Systems can create new 19c database or new 19c Database home
  - Patching existing 19c Databases and Grid Infrastructures is possible

- New/Pending
  - Upgrading to 19c Oracle Grid Infrastructure on Exadata Cloud Service (Doc ID 2624992.1)
  - Upgrading to 19c Oracle Database on Exadata Cloud Service
Final Tip: Leverage Cloud Documentation and MAA Cloud OTN Collateral

Refer to MAA Cloud OTN
- Oracle Cloud: Maximum Availability Architecture Presentation
- OOW 2019 Presentation: Oracle MAA for Oracle Database, Exadata, and the Cloud
- OOW 2019 Presentation: Best Practices for Oracle Exadata Cloud Deployments
- Continuous Availability - Application Checklist for Continuous Service for MAA Solutions
- Oracle GoldenGate Microservices Architecture on Oracle Cloud Infrastructure
- Oracle Cloud Infrastructure Exadata Backup & Restore Best Practices using Cloud Object Storage
- Hybrid Data Guard (new and updated)
  - Hybrid Data Guard to Exadata Cloud Services - Production Database on Premises and Disaster Recovery with Exadata Cloud
  - Hybrid Data Guard to ExaCC Production Database on Premises and Disaster Recovery on Exadata Cloud@Customer
  - Hybrid Data Guard to Exadata Cloud Services - Production Database on Premises and Disaster Recovery with Exadata Cloud Gen 2

Refer to Exadata Cloud Documentation
- Exadata OCI: [https://docs.cloud.oracle.com/iaas/Content/Database/Concepts/exaoverview.htm](https://docs.cloud.oracle.com/iaas/Content/Database/Concepts/exaoverview.htm)
- Exadata Cloud@Customer: [https://docs.cloud.oracle.com/iaas/Content/Database/Concepts/eccoverview.htm](https://docs.cloud.oracle.com/iaas/Content/Database/Concepts/eccoverview.htm)
- Exadata Autonomous Database: [https://docs.cloud.oracle.com/iaas/Content/Database/Concepts/adboverview.htm](https://docs.cloud.oracle.com/iaas/Content/Database/Concepts/adboverview.htm)