Converged Oracle Database MAA in the world of hybrid cloud and multicloud deployments

Glen Hawkins
Senior Director of Product Management
Oracle Maximum Availability Architecture & Data Guard
History lesson: Developers built applications using a single development platform and data store
Modern Apps Need To **Generate Value From Data in New Ways**
Modern Apps Need To **Generate Value From Data in New Ways**

- Machine Learning
- Real-Time Analytics
- IoT
- Graph Analysis
- Documents
- Text Search
- Spatial Processing
- Blockchain
Modern Apps Are **Built Using New Development Methodologies**

- CI/CD
- Microservices
- Events
- SaaS
- Distributed Data
- Low Code
- Defense in Depth
- API Driven Development
- JSON
Modern App Requirements **Lead to an Alternative Approach**

Run **Single-Purpose**, "best-of-breed" database for each data type and workload

![Database Icons](image)

- Document
- Spatial
- Blockchain
- Text Search
- Reporting
- ML
- Graph
Modern App Requirements Lead to an Alternative Approach

Advantage

Run Single-Purpose, "best-of-breed" database for each data type and workload

- Document
- Spatial
- Blockchain
- Text Search
- Reporting
- ML
- Graph

Each database offers a convenient data model that fits the purpose and has easy to adopt APIs for developers that seem natural for that data model
Modern App Requirements Lead to an Alternative Approach

Disadvantage

Even small apps need multiple data types and workloads, so you will need multiple single-purpose databases, fragmenting the data
Modern App Requirements **Lead to an Alternative Approach**

Disadvantage

Fragments development, locks-in app to one single-purpose database
Modern App Requirements Lead to an Alternative Approach

Disadvantage

Every App Requires distributed execution and data movement across multiple fragmented databases

Inherently difficult and causes unavoidable data delays and data divergence
Modern App Requirements **Lead to an Alternative Approach**

**Disadvantage**

Developers become focused on **Integrating fragmented databases** to create a complete, available, secure, and scalable solution, instead of **innovating**.
Modern App Requirements Lead to an Alternative Approach

Disadvantage

Each single purpose database requires **specialized skills and unique management**
Modern App Requirements Lead to an Alternative Approach

Disadvantage

In addition, each of these specialized databases routinely has a completely different security, high availability, and disaster recovery paradigm creating operational silos into the architecture usually leading to complex maintenance operations, more downtime, and prolonged recovery in the case of a disaster event.
How Do you Manage This Level of Complexity?
The Easier Way

Simplifying new development methodologies with synergistic data technologies
The Easier Way

Simplifying new development methodologies with synergistic data technologies

Eliminating data fragmentation with a single Converged Database for all data types and uses
Simplifying new development methodologies with synergistic data technologies

Eliminating data fragmentation with a single Converged Database for all data types and uses

Providing easy to use declarative implementations of the new data uses and types in the core database
Oracle Database – core, user-driven capabilities

- High Availability & Application Continuity
- Manageability
- Scalability & Multitenant
- Performance
- Security
Oracle Database – converged by design

Multiple data types

- Spatial
- Graph
- Blockchain
- JSON
- Application development
- IoT
- Transactions
- Data Science & Analytics

Multiple workloads
Oracle Database – all-inclusive and converged by design

- 100+ spatial operators and functions
- 50+ graph analysis algorithms
- Tamper-resistant Blockchain tables
- Schemaless app development
- JSON
- 30+ in-database ML algorithms
- Transactional event queues
- IoT streaming data (real-time analytics)
- APEX low-code app development platform
Oracle’s converged database - enabling the data-driven enterprise

Do more with less
A unified approach to data management means more opportunity for data synergies, and less maintenance overhead

Shorten time to value
Accelerate application development – with easier data access and support for the latest development methodologies

Modernize workloads
Flexible deployment options to meet your specific needs, and ease of movement between those deployment options
Oracle Database, The Converged Database is Available Everywhere
Autonomous Data Warehouse Delivers Fast and Easy Data Driven Insights

**Built-In Data Acquisition**
Discover and Extract data from hundreds of sources including Object Store, Drag-n-drop tools for Bulk & Real-Time Load and Transformation

**Embedded Analytic Engines**
Graph Analytics, Spatial Analytics, Cube (Multidimensional) Analytics, Document Analytics, Relational Analytics, and Machine Learning

**Automated Analytics**
Automatically creates business models, discovers hidden insights, and builds machine learning models

**Autonomous with Converged Architecture**
Simplicity of automated full stack analytics enables business users and data scientists to quickly unlock value from data
How Does the Converged Database Ensure Business Continuity?
Key terminology

High availability
A system type with redundant components that provides consistent and uninterrupted service, even in the event of hardware or software failures.

Disaster Recovery
A method of protecting computer systems from failure, in which standby equipment automatically takes over when the main system fails.

Scalability
The ability to add additional nodes to database environments thereby maintaining and achieving improved performance.

Recovery Point Objective (RPO)
Tolerance for data loss (sec’s, hours, days); determines frequency of backups and replication approaches.

Rolling updates/patches
The process where software is developed continuously, and the updates are released in between the major releases. These updates are compatible with earlier versions where complete re-installation of the software is not required.

Recovery Time Objective (RTO)
The shorter the Recovery Time Objective (RTO) the quicker you get back to business.
Oracle Maximum Availability Architecture (MAA)
Standardized Reference Architectures for Never-Down Deployments

Customer insights and expert recommendations

Reference architectures

Production site

Replication

Replicated site

HA features, configuration and operational practices

Deployment choices

Generic Systems
Engineered Systems
BaseDB, ExaDB/ExaCC
Autonomous DB

Zero Downtime Migration (ZDM)

Continuous availability
- Application Continuity
- Online Redefinition
- Edition-based Redefinition

Data protection
- Flashback
- RMAN
- ZDLRA+ ZRCV

Active replication
- Active Data Guard
- Full Stack DR
- GoldenGate

Scale out & Lifecycle
- RAC
- FPP
- Globally Distributed Database
## MAA reference architectures
### Availability service levels

<table>
<thead>
<tr>
<th>Bronze</th>
<th>Silver</th>
<th>Gold</th>
<th>Platinum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dev, test, prod</td>
<td>Prod/departmental</td>
<td>Business critical</td>
<td>Mission critical</td>
</tr>
<tr>
<td>Single instance DB</td>
<td>Bronze +</td>
<td>Silver +</td>
<td>Gold +</td>
</tr>
<tr>
<td>Restartable</td>
<td>Database HA with RAC</td>
<td>DB replication with Active Data Guard</td>
<td>GoldenGate</td>
</tr>
<tr>
<td>Backup/restore</td>
<td>Application Continuity</td>
<td>Goldedefinition</td>
<td>Edition Based Redefinition</td>
</tr>
<tr>
<td>Optional - ZDLRA</td>
<td>Optional - Exadata</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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## BRONZE

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

- Single Instance with Clusterware Restart
- Advanced backup/restore with RMAN
  - Optional ZDLRA with incremental forever and near zero RPO
- Storage redundancy and validation with ASM
- Multitenant Database/Resource Management with PDB features
- Online Maintenance
- Some corruption protection
- Flashback technologies

### Outage Matrix

**Unplanned Outage**

<table>
<thead>
<tr>
<th>Event</th>
<th>RTO / RPO Service Level Objectives (f1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recoverable node or instance failure</td>
<td>Minutes to hour (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>
</tr>
</tbody>
</table>

**Planned Maintenance**

- Software/hardware updates: Minutes to hour (f2)
- Major database upgrade: Minutes to hour

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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
Silver

Prod/Departmental

Bronze +
- Real Application Clustering (RAC)
- Application Continuity
- Sharding (Optional)
  - Provides fault isolation, scalability and geographical distribution

Outage Matrix

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<th>RTO/RPO Service Level Objectives(f1)</th>
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</thead>
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<tr>
<td>Recoverable node or instance failure</td>
<td>Single digit seconds (f2)</td>
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<td>Hours to days. RPO since last backup or near zero with ZDLRA</td>
</tr>
</tbody>
</table>

Planned Maintenance

| Software/Hardware updates                       | Zero (f2)                            |
| Major database upgrade                          | Minutes to hour                       |

f1: RPO=0 unless explicitly specified
f2: To achieve zero downtime or lowest impact, apply application checklist best practices; Batch jobs should be deferred outside planned maintenance window.
Mission Critical

Silver +
- Active Data Guard or Data Guard
- Comprehensive Data Protection

MAA Architecture:
- At least one standby required across AD or region.
- Primary in one data center(or AD) replicated to a Standby in another data center.
- Data Guard Fast-Start Failover (FSFO)
- Local backups on both primary and standby

Outage Matrix

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<tr>
<td>Recoverable node or instance failure</td>
<td>Single digit seconds (f2)</td>
</tr>
<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 the lowest impact, apply application checklist best practices. Batch jobs should be deferred outside the planned maintenance window.
### Gold +
- GoldenGate Active/Active Replication
- Edition-based Redefinition (Alternative)

### MAA Architecture:
- Each GoldenGate “primary” replica protected by Exadata, RAC and Active Data Guard
- Primary in one data center (or AD) replicated to another Primary in remote data center (or AD)
- Oracle GG or Edition-based Redefinition for zero downtime application upgrade
- Local backups on both sites
- Achieve zero downtime through custom failover to GG replica

### Outage Matrix

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<th>RTO/RPO Service Level Objectives</th>
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</thead>
<tbody>
<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>

<table>
<thead>
<tr>
<th>Planned Maintenance</th>
<th>RTO/RPO Service Level Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most common software/hardware updates</td>
<td>Zero (f2)</td>
</tr>
<tr>
<td>Major database upgrade, application upgrade</td>
<td>Zero (f3)</td>
</tr>
</tbody>
</table>

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
Hybrid Cloud: recommended hybrid sources/destinations

- All Hybrid configurations are achieved manually: no Control Plane automation
- On-premises non-Exadata to ExaDB-C@C/ExaDB-D is possible but beware of exclusive features
Hybrid Data Guard: overview

### AVAILABILITY / AUTOMATION (1)

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔐</td>
<td>Backup to the cloud</td>
</tr>
<tr>
<td>🔐</td>
<td>Customer-specific</td>
</tr>
<tr>
<td>🔐</td>
<td>Instantiate &amp; operate Data Guard configuration</td>
</tr>
<tr>
<td>🏞️</td>
<td>Manual (capture &amp; delivery)</td>
</tr>
</tbody>
</table>

#### Hybrid Data Guard: overview

- **RMAN**: Backup to the cloud
- **RAC**: Customer-specific
- **ACTIVE DATA GUARD**: Instantiate & operate Data Guard configuration
- **GOLDENGATE**: Manual (capture & delivery)

#### Gold Outage Matrix (2)

<table>
<thead>
<tr>
<th>Event Type</th>
<th>SILVER</th>
<th>GOLD</th>
<th>PLATINUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLANNED MAINTENANCE</td>
<td>ZERO</td>
<td>ZERO</td>
<td></td>
</tr>
<tr>
<td>RECOVERABLE FAILURE</td>
<td>ZERO</td>
<td>SECONDS</td>
<td></td>
</tr>
<tr>
<td>UNRECOVERABLE FAILURE</td>
<td>ZERO</td>
<td>SECONDS</td>
<td></td>
</tr>
<tr>
<td>UPGRADE</td>
<td>ZERO</td>
<td>SECONDS</td>
<td></td>
</tr>
</tbody>
</table>

(1) Customer responsibility
(2) Best case scenario (FSFO + SYNC or FAR SYNC)

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Multicloud MAA Gold Tier Example

- All multicloud configurations are achieved manually: no Control Plane automation
- Azure Interconnect available in some regions
Multicloud MAA Platinum Tier Example

- Oracle GoldenGate Hub in a high availability configuration would be manual in Oracle Cloud
- Azure Interconnect available in some regions
- All multicloud configurations are achieved manually: no Control Plane automation
How does the MAA team ensure Oracle Database availability, performance and scalability?
MAA & Chaos Engineering – Breaking things to ensure your peace of mind

**Chaos Engineering** is the art form of experimenting (i.e. proactively breaking things) on a system in order to build confidence in a system’s resilience to withstand turbulent events in production.

In today’s digital age, this may include but is not limited to:

- Network, server & storage failures
- Human errors & data corruption
- Data corruption
- Power failures or site failure (i.e. Godzilla attack or hurricane)
- Application, database & server software updates
- Data reorganization or changes
- Application changes and optimizations
Summary

1. Oracle makes it simple to build Data Driven Apps by providing **Synergistic Data Technologies** for each modern Development Methodologies

2. One Converged Database for all data types and model engineered so they all work together enables **Cross Data Synergy**

3. One Converged Database **greatly simplifies development, operations and overall architecture including high availability, disaster recovery and security.**