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Oracle Maximum Availability Architecture (MAA)

Blueprints for reduced planned and unplanned downtime for the On-Premises, Exadata-based or Cloud-base Oracle Database.
Program Agenda

1. Why Availability is Important
2. MAA Blueprint for Oracle On-Premise
3. Summary and Resources
Maximum Availability Architecture (MAA)

Why Availability is Important
MAA Solutions: On-Premises to Cloud

On-Premises Exadata and Recovery Appliance

MAA Reference Architectures and Best Practices

MAA integrated Engineered Systems (config practices, exachk, lowest brownouts, HA QoS, data protection)

Adding MAA Config and Life Cycle Operations, Shifting Admin Ownership to Oracle with MAA SLAs

Autonomous Database

DBCS/ExaCS/ExaCC
Impact of Database Downtime

- Average cost of downtime per hour: $350K
- Average cost of unplanned data center outage or disaster: $10M
- Average amount of downtime per year: 87 hours
- Percentage of companies that have experienced an unplanned data center outage in the last 24 months: 91%

Source: Gartner, Data Center Knowledge, IT Process Institute, Forrester Research
Oracle Maximum Availability Architecture (MAA)

High Availability, Disaster Recovery and Data Protection

Applying 30+ years of lessons learned in solving toughest HA problems around the world

Solutions to reduce downtime for planned & unplanned outages for Enterprise customers with most demanding workloads and requirements

Service level oriented MAA reference architectures

Books, white papers, blueprints

MAA integrated Engineered Systems

Continuous feedback into products

https://oracle.com/goto/maa
### MAA Reference Architectures

Meet Downtime (RTO) and Data Loss (RPO) SLAs

<table>
<thead>
<tr>
<th>MAA Reference Architectures</th>
<th>Topology</th>
<th>Suitable Databases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BRONZE</strong></td>
<td>Single Instance + Backup</td>
<td>Dev, Test, Prod</td>
</tr>
<tr>
<td><strong>SILVER</strong></td>
<td>HA Clustering + Backup</td>
<td>Prod/Departmental</td>
</tr>
<tr>
<td><strong>GOLD</strong></td>
<td>HA Clustering + Disaster Recovery + Backup</td>
<td>Mission Critical</td>
</tr>
<tr>
<td><strong>PLATINUM</strong></td>
<td>Zero Data Loss &amp; Zero Downtime</td>
<td>Extreme Critical</td>
</tr>
</tbody>
</table>

Addresses SLAs for Data Loss and Downtime during Planned & Unplanned Outages
Oracle Maximum Availability Architecture (MAA)

Reference Architectures

Production Site

Replicated Site

Replication

Customer Insights & Expert Recommendations

HA Features, Configurations & Operational Practices

Platinum
Gold
Silver
Bronze

Deployment Choices

Generic Systems
Engineered Systems
DBCS ExaCS/ExaCC
Autonomous DB

Continuous Availability
Application Continuity
Global Data Services

Data Protection
Flashback
RMAN + ZDLRA

Active Replication
Active Data Guard
GoldenGate

Scale Out
RAC
ASM
Sharding
Oracle MAA

Designed to Address the Complete Range of Business Requirements

On Premises

Oracle Database

On Cloud

Common Platform – On Premises, Cloud, and Hybrid Cloud

Big Differentiator
Oracle Enterprise Manager Cloud Control (OEM)

Configuration, Monitoring, Alerting and Management

Data Guard / Active Data Guard
Multitenant
Zero Data Loss Recovery Appliance (ZDLRA)
Recovery Manager (RMAN)
Real Application Clusters (RAC)
Edition Based Redefinition (EBR)
Oracle Sharding
Oracle GoldenGate (OGG) – Monitoring and Alerting Only
Maximum Availability Architecture (MAA)

MAA Blueprint for Oracle On-Premise
Reference Architectures – Level Set

Blueprints developed and certified by Oracle
Validated by 10,000s of Oracle Customers

Capabilities carry forward as you progress from one tier to the next

Achieving stated service levels requires:
  • Utilization of prescribed features and capabilities
  • Utilization of prescribed configuration and operational best practices
  • Due diligence during pre-production testing
  • Due diligence on all life cycle operations
  • Maintaining recommended patch levels and versions
BRONZE

**Dev, Test, Prod** - Single Instance 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
- Inherent corruption protection
- Flashback technologies

**Outage Matrix**

<table>
<thead>
<tr>
<th>Unplanned Outage</th>
<th>RTO / RPO*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recoverable node or instance failure</td>
<td>Minutes to hour</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             |
- Major database upgrade                            | Minutes to hour             |

* RPO=0 unless explicitly specified
Oracle Clusterware for Automatic Restart

1. Oracle Clusterware is available for all Oracle Databases
2. Enables HA capabilities and resource management:
   • **Automatic Restart** of database instances, listeners and other resources
   • Fleet patching
   • Service management including restarting service after failure
   • Automatic Storage Management (ASM) for HA, data protection and ease of use

Trade off: additional software maintenance for Grid Infrastructure
Oracle Multitenant

Architecture for consolidating databases and simplifying operations

Self-contained PDB for each application
- Portability (via pluggability)
- Rapid provisioning (via clones)
- Applications run unchanged
- PDB upgrades via plug/unplug

Common operations performed at CDB level
- Manage many as one (upgrade, backups, HA)
- Granular control when appropriate
- Simple DR

Shared memory and background processes
- More applications per server

MAA and Multitenant
- Solutions for planned / unplanned outages
Pluggable Database Backup, Restore and Recovery

Backup and restore pluggable database …
Create Restore Point ‘before_event’ for pluggable database…
  - Normal or Guaranteed Restore Point
  - Clean Restore Point

Flashback Pluggable Database
Complete ZDLRA support
Oracle Recovery Manager - RMAN

Database Integrated Backup and Recovery

Unique knowledge of database file formats and recovery procedures

- Oracle block validation
- Online block-level recovery
- Native encryption, compression
- Table/partition-level recovery
- Oracle Multitenant support

Tape and cloud backups

Unified Management
RMAN Enhancements for Table Recovery

1) Check Auxiliary Instance Disk Space
   • Automated Table Recovery requires disk space for SYSTEM, SYSAUX, UNDO and User Tablespace(s)
   • Pre-check for space in the Auxiliary Instance disk space to avoid failures in the middle of the process

2) Recovery Across Schema
   • Enables Table level recovery under different schema
   • Provide OLD: NEW Schema(s) under REMAP TABLE

   ```sql
   RECOVER TABLE hr.department, sales.product
   UNTIL SCN 1234 AUXILIARY DESTINATION '/tmp/' REMAP TABLE
   hr.department:dev.testdepartment, sales.product:mkt.newproduct;
   ```
Recovery Appliance Recommended

Databases

Transaction Block Changes

Oracle DB 12c-19c on Any Platform

No More Full Backups, Incremental Forever

End-to-End Oracle Recovery Validation
Near Zero Data Loss for DR

EM Real-Time Protection Status & Space Monitoring

Cloud Storage

Remote Replica

Tape

Day 1 Full
Day 2 Changes
Day N State

Virtual Full Backup

Day 1 State
Day 2 State
Day N State

Transactional Block Changes

Near Zero Data Loss for DR

Oracle DB 12c-19c on Any Platform

No More Full Backups, Incremental Forever
# Database and Exadata Health Checks

## Assessment Report

Health Score, Summary, Findings

### Oracle Exadata Assessment Report

System Health Score is 89 out of 100 (detail)

<table>
<thead>
<tr>
<th>Cluster Summary</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cluster Name</strong></td>
<td>cloner1</td>
</tr>
<tr>
<td><strong>Database version</strong></td>
<td>Oracle 11G</td>
</tr>
<tr>
<td><strong>DB Home Version</strong></td>
<td>11.2.0.4.0.1, 11.2.0.4.3 , 12.2.0.3.3.0.1</td>
</tr>
<tr>
<td><strong>Enable Version</strong></td>
<td>11.2.0.4.0.1, 11.2.0.4.3 , 12.2.0.3.3.0.1</td>
</tr>
<tr>
<td><strong>Number of nodes</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Database servers</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>I/O Switches</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Oracle Version</strong></td>
<td>11.2.0.4.0.1, 11.2.0.4.3 , 12.2.0.3.3.0.1</td>
</tr>
<tr>
<td><strong>Calculation</strong></td>
<td>exahdb_READS/EXAHBU_19145173</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>36 days, 19 seconds</td>
</tr>
<tr>
<td><strong>Execute by</strong></td>
<td>exa</td>
</tr>
<tr>
<td><strong>Calculation Date</strong></td>
<td>29-JUL-2018 14:11:38</td>
</tr>
</tbody>
</table>

Note: As of Oracle Database 11g Release 12.2.0.3 or above, the result of the Oracle Exadata Data Health Check is no longer available. For more information, please refer to the Oracle Exadata Data Health Check document. For any Oracle database using 12.2.0.3 or later, please refer to the modified version.

**Warning:** The data collection activity appears to be the same as the previous version. Please review the "Helpful Resources" and "Useful Links" section and refer to "Support & Tutorials" for additional information.

**Note:** Automated Orachk/Exachk Healthcheck MOS 107954.1 updated frequently

## Findings & Recommendations

How to Solve the problem?

### Database Server

<table>
<thead>
<tr>
<th>Status</th>
<th>Type</th>
<th>Message</th>
<th>Status On</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAIL</td>
<td>SQL Parameter Check</td>
<td>ASH profile SCA. TARGET IS NOT set according to recommended value.</td>
<td>All Instances</td>
<td>FAIL</td>
</tr>
<tr>
<td>WARNING</td>
<td>PDB Check</td>
<td>PDB is not enabled or configured on NO_NAME_VALUE</td>
<td>All Names</td>
<td>FAIL</td>
</tr>
<tr>
<td>WARNING</td>
<td>DBC Check</td>
<td>Database parameter enable, NLSA support should be set to recommended value.</td>
<td>All Database Servers</td>
<td>FAIL</td>
</tr>
</tbody>
</table>

**Recommendation:**

As of Oracle Database 12c Release 2.0.0.4.0.3 or above, the enabling of NLSA in the database is automatic so no action is necessary on any Oracle database. For any Cloud database using 12.2.0.4.0.1 or later, please refer to the recommended value. NLSA support in the database should always be on or Exadata OVM.

### MAA Score Card

MAA architectural readiness and configuration practices

Note: Automated Orachk/Exachk Healthcheck MOS 107954.1 updated frequently
Online Operations

Online Redefinition Improvements

DBMS_REDEFINITION allows you to reorganize and redefine tables online

• Add/drop/rename/reorder columns
• Switch physical storage structures
• Reorganize & transform data while online

Additional Benefits of using DBMS_REDEFINITION

• Fault Tolerant (resume at point of failure) and track changes to enable fast rollback to prior definition
• Entire redefinition process runs without acquiring Exclusive DDL lock
• Monitor reorganization using V$online_redef
### Online Operations

**All Partition Maintenance Operations are now Online**

| 11.2 & Prior | Create index online, rebuild index online, rebuild index partition online  
Add Column, Add Constraint enable novalidate |
|--------------|------------------------------------------------------------------|
| 12.1         | Online move partition  
Drop index online  
Set unused column online, alter column visible/invisible, alter index unusable online, alter index visible/invisible  
alter index parallel/noparallel |
| 12.2         | Alter table move online for non-partitioned tables  
Alter table from non-partitioned to partitioned online  
Alter table split partition online  
Create table for exchange (usable for online partition exchange)  
Move/merge/split partition maintenance operations can now do data filtering |
| 18.1, 19c    | Alter table modify partitioned table to a **different partitioning method** (e.g., hash to range)  
Alter table **merge partition/sub-partition** online |
Flashback Technologies
Rewind Button for Oracle Databases

- Fast point-in-time recovery (PITR) without expensive restore operation
- Error investigation
  - View data as of previous point in time
- Error correction
  - Back-out a transaction
  - Incorrect table updates
  - Rewind the entire database
### SILVER

**Prod/Departmental**

- Real Application Clustering (RAC)
- Application Continuity

---

#### Outage Matrix

<table>
<thead>
<tr>
<th>Unplanned Outage</th>
<th>RTO/RPO*</th>
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<tbody>
<tr>
<td>Recoverable node or instance failure</td>
<td>Seconds</td>
</tr>
<tr>
<td>Disasters: corruptions and site failures</td>
<td>Hours to days.</td>
</tr>
<tr>
<td></td>
<td>RPO since last</td>
</tr>
<tr>
<td></td>
<td>backup or near</td>
</tr>
<tr>
<td></td>
<td>zero with ZDLRA.</td>
</tr>
</tbody>
</table>

#### Planned Maintenance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Software/hardware updates</td>
<td>Zero</td>
</tr>
<tr>
<td>Major database upgrade</td>
<td>Minutes to hour</td>
</tr>
</tbody>
</table>

* RPO=0 unless explicitly specified
Oracle Real Application Clusters (Oracle RAC)

Node Failure, Instance Failure, Rolling Maintenance

- Utilizes two or more instances of an Oracle Database concurrently
- Very Scalable
  - All instances active; Add capacity online; Ideal for database consolidation
- Highly Available
  - Auto-failover of services to an already running instance; Outage is transparent to user, in-flight transactions succeed; Zero downtime rolling maintenance
**Transparent Application Continuity (TAC)**

Application does not see errors during outages

- Uses Application Continuity and Oracle Real Application Clusters
- Transparently tracks and records session information in case there is a failure
- Built inside of the database, so it works without any application changes
- Rebuilds session state and replays in-flight transactions upon unplanned failure
- Planned maintenance can be handled by TAC to drain sessions from one or more nodes
- Adapts as applications change: protected for the future
## Transparent Application Continuity Explained

### Normal Operation
- Client marks requests: explicit and discovered.
- Server **tracks session state**, decides which calls to replay, disables side effects.
- Directed, client holds original calls, their inputs, and validation data.

### Failover Phase 1: Reconnect
- Checks replay is enabled
- Verifies timeliness
- Creates a new connection
- Checks target database is legal for replay
- Uses Transaction Guard to guarantee commit outcome

### Failover Phase 2: Replay
- Restores and verifies the session state
- Replays held calls, restores mutables automatically
- Ensures results, states, messages match original.
- On success, returns control to the application
Checklist for Achieving Zero Application Downtime

1. Use Oracle Clusterware Service (never use default service)
2. Use Recommended Connection String
3. Configure FAN for Connection Pool
4. Drain your service
5. Use Application Continuity or Transparent Application Continuity

1) MAA Whitepaper: Application Checklist for Continuous Service for MAA Solutions
2) Using RHPhelper to Minimize Downtime During Planned Maintenance on Exadata (MOS 2385790.1)
3. Fleet Patch and Provisioning incorporates MAA practices
Outage Matrix

Unplanned Outage  |  RTO/RPO*
---|---
Recoverable node or instance failure  |  Seconds
Disasters: corruptions and site failures  |  Seconds. RPO zero or seconds

Planned Maintenance

- Software/hardware updates  |  Zero
- Major database upgrade  |  Seconds

*  RPO=0 unless explicitly specified
Storage Remote Mirroring Architecture

Generic - Must Transmit Writes to All Files

...INCLUDING CORRUPTED BLOCKS OR BAD DATA

Oracle Instance (in memory)

Sync or Async block replication

Primary Database

Mirrored Volumes

- Zero Oracle validation
- 7x network volume
- 27x network i/o
Data Guard Addresses Shortcomings of Storage Replication

Inadequate isolation, zero application-level validation

“...when something happens in the I/O stack and a database write is malformed Symmetrix A happily replicates the faulty data to site B and the corruption goes undetected”

EMC BLOG with Integrity
# Oracle Data Protection

**Gold – Comprehensive Data Protection**

<table>
<thead>
<tr>
<th>Capability</th>
<th>Physical Block Corruption</th>
<th>Logical Block Corruption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dbverify, Analyze</td>
<td>Physical block checks</td>
<td>Logical checks for intra-block and inter-object consistency</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RMAN, ASM</td>
<td>Physical block checks</td>
<td>Intra-block logical checks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Active Data Guard</strong></td>
<td>• Continuous physical block checking at standby</td>
<td>• Detect lost write corruption, auto shutdown and failover</td>
</tr>
<tr>
<td></td>
<td>• Strong isolation to prevent single point of failure</td>
<td>• Intra-block logical checks at standby</td>
</tr>
<tr>
<td></td>
<td>• Automatic repair of physical corruptions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Automatic database failover (option for lost writes)</td>
<td></td>
</tr>
<tr>
<td><strong>Runtime</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Database</td>
<td>In-memory block and redo checksum</td>
<td>In-memory intra-block checks, shadow lost write protection</td>
</tr>
<tr>
<td>ASM</td>
<td>Automatic corruption detection and repair using extent pairs</td>
<td></td>
</tr>
<tr>
<td>Exadata</td>
<td>HARD checks on write, automatic disk scrub and repair</td>
<td>HARD checks on write</td>
</tr>
</tbody>
</table>
Active Data Guard Overview

Primary
Open Read-Write

Standby
Open Read-Only

Offload read only or read mostly workloads to the standby database

Zero Data Loss at any Distance

DML Redirection

Automatic Block Repair

- Synchronous zero data loss replication
- Database rolling upgrade to reduce downtime for planned maintenance
- Automatic failover for High Availability

Multi-instance Redo Apply for RAC (In Memory supported)
Active Data Guard Far Sync

Zero Data Loss Protection at Any Distance

**SYNC**
- Limited distance
- Far Sync Instance
  - Oracle control file and log files
  - No database files
  - No media recovery
  - Offload transport compression and/or encryption

**ASYNC**
- Any distance
  - Redo compressed over WAN
- Active Standby Database
  - Zero data loss failover target
  - Database open read-only
  - Continuous Oracle validation
  - Manual or automatic failover

Primary Database
- Production copy
Extend Footprint of ADG Applications

Support for DML Re-direction

- DML Re-direction is automatically performed from an Active Data Guard standby to the primary (ACID uncompromised)
- New parameter ADG_REDIRECT_DML controls DML Redirection
- New ADG_REDIRECT_DML and ADG_REDIRECT_PLSQL
- “Read-Mostly, Occasional Updates” applications supported for Oracle Database 19c
Preserve Buffer Cache During Role Change

The database buffer cache state is preserved on an ADG standby during a role change.

Automatically enabled
- Configure services so that users can stay connected on a service that is valid in both PHYSICAL_STANDBY and PRIMARY roles.

Supported versions:
- Oracle Database 18c – Single Instance
- Oracle Database 19c – Oracle RAC Support
Multi-Instance Redo Apply Performance

Lower Latency Active Data Guard Standby Databases

- Utilizes all RAC nodes on the Standby database to parallelize recovery
- OLTP workloads on Exadata show great scalability
Database Rolling Upgrade to 19c

Database Rolling Upgrade with DBMS_ROLLING

- Pre-checks and early problem detection
- Fault tolerant, resumable and rollback capabilities
- Three Role Transition Steps: Start, Switchover, Finish
- Potential Maintenance Window: Hours
- Potential Database and Application Downtime: Seconds

Automated Database Upgrades using Oracle Active Data Guard and DBMS_ROLLING
Oracle Multitenant

Architecture for consolidating databases and simplifying operations

- Self-contained PDB for each application
  - Portability (via pluggability)
  - Rapid provisioning (via clones)
  - Applications run unchanged
  - PDB upgrades via plug/unplug

- Common operations performed at CDB level
  - Manage many as one (upgrade, backups, HA)
  - Granular control
  - Simple DR

- Shared memory and background processes
  - More applications per server

- MAA and Multitenant
  - Solutions for planned / unplanned outages
PDB Failover: Normal Runtime

CDB 1
Read-Write

CDB 1
Standby
Read-Only

Data Guard

CDB 2
Read-Write
PDB Failover after PDB 2 Outage

Unplug/plug PDB2 from CDB1 standby to CDB2 and failover application connections
## Multitenant “Gold” MAA

<table>
<thead>
<tr>
<th>Unplanned Outages</th>
<th>Key Features for Solution</th>
<th>RTO</th>
<th>RPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recoverable node or instance failure</td>
<td>Real Application Cluster (RAC) Application Continuity (AC/TAC)</td>
<td>Secs</td>
<td>Zero</td>
</tr>
<tr>
<td>Disasters: corruptions and site failures</td>
<td>Active Data Guard Fast-Start Failover</td>
<td>Secs</td>
<td>Zero or Secs</td>
</tr>
</tbody>
</table>

- **PDB unrecoverable failure or “sick” PDB (NEW)**
  - PDB Failover (unplug/plug)
  - Another target CDB on the same cluster required (MOS 2088201.1)
  - Secs
  - Zero or Secs

<table>
<thead>
<tr>
<th>Planned Maintenance</th>
<th>Solution</th>
<th>RTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software and hardware updates</td>
<td>RAC, AC or TAC</td>
<td>Zero</td>
</tr>
<tr>
<td>Major database upgrade</td>
<td>Active Data Guard DBMS_ROLLING</td>
<td>Secs</td>
</tr>
<tr>
<td>Migration to remote CDB (NEW)</td>
<td>PDB Relocate</td>
<td>Mins</td>
</tr>
<tr>
<td>Migration plus upgrade (NEW)</td>
<td>PDB Relocate + Upgrade</td>
<td>Mins</td>
</tr>
</tbody>
</table>
Refreshable PDB Switchover

Per-PDB replica with only two CDBs to manage!

1. create pluggable database Red;
4. create pluggable database Brown;
6. create pluggable database Grey from Grey@CDB2_Link
   refresh mode every 2 minutes;

2. create pluggable database Red from Red@CDB1_Link
   refresh mode every 2 minutes;
3. create pluggable database Gold;
5. create pluggable database Grey;
1. alter pluggable database Grey refresh mode every 2 minutes from Grey@dblink switchover;
Refreshable PDB Switchover

Unplanned switchover

Does not interoperate with Data Guard Fast-Start Failover, auto-block repair, DB rolling upgrade so NOT part of Gold MAA

1. alter pluggable database Grey refresh;
2. alter pluggable database Grey refresh mode none;
3. alter pluggable database Grey open read write;
Gold +
- GoldenGate Active/Active Replication
- Optional Editions Based Redefinition

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

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</table>

<table>
<thead>
<tr>
<th>Planned Maintenance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Software and hardware updates</td>
<td>Zero</td>
</tr>
<tr>
<td>Major database upgrade, application upgrade, migration</td>
<td>Zero**</td>
</tr>
</tbody>
</table>

* RPO=0 unless explicitly specified  ** application failover is custom
GoldenGate plus 2 Optional Approaches to Further Protect Your Applications

Use Oracle Golden Gate
- Required

Use Edition-based Redefinition
- Optional

Use Oracle Sharding
- Alternative
GoldenGate plus 2 Optional Approaches to Further Protect Your Applications

Use Oracle Golden Gate
Required

Use Edition-based Redefinition
Optional

Use Oracle Sharding
Alternative
Oracle GoldenGate Microservices Architecture

Capture: committed transactions are captured (and can be filtered) as they occur by reading the transaction logs.

Trail: stages and queues data for routing.

Distribution Server/Receiver: distributes data for routing to target(s).

Route: data is compressed, encrypted for routing to target(s).

Delivery: applies data with transaction integrity.

Source
Oracle & Non-Oracle Database(s)

Trail Files
Dist. Service
Receiver Service

Target
Oracle & Non-Oracle Database(s)

Trail Files
Dist. Service
Receiver Service

Bi-directional
LAN / WAN / Internet
Over TCP/IP
Key GoldenGate Improvements Simplify Platinum

1. GoldenGate Hub simplifies migration and administration by offloading work from source and target
   - New GoldenGate cloud market place automates GG hub deployment
   - Cross endianness capture enables cross platform migration
   - Upcoming Zero Downtime Migration integration with GoldenGate

2. GoldenGate Microservices simplifies administration and management

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Oracle GoldenGate

MAA Best Practices

• Transparent Role Transitions in Data Guard Configurations
  • No manual intervention required with FSFO and DG Broker
• Configuration makes use of:
  • Oracle Grid Infrastructure Bundled Agent (XAG)
  • DBFS or ACFS for shared GoldenGate files (trails and checkpoint files)
  • Role based services
  • Integrated Extract (with HANDLEDLFAILOVER option for ASYNC DG)
  • Microservices Architecture for simpler administration
Sample Deployment

Primary Database

Observer

Standby Database

Bidirectional GoldenGate Replication

Integrated Extract

LogMining Server

Redo Transport (SYNC or ASYNC)

Trail and other OGG Files In DBFS

Redo Transport

OCI Connection

File I/O

Warehouse
Sample Deployment – Post Role Transition

(OLD) Primary Database

Observer

(NEW) Primary Database

LogMining Server

Redo Transport (SYNC or ASYNC)

Integrated Extract

Trail/Checkpoint/BR Files In DBFS

Bidirectional GoldenGate Replication

Warehouse

Redo Transport

OCI Connection

File I/O
GoldenGate plus 2 Optional Approaches to Further Protect Your Applications

- **Use Oracle Golden Gate**: Required
- **Use Edition-based Redefinition**: Optional
- **Use Oracle Sharding**: Alternative
Edition-Based Redefinition

Online Application Upgrade

- Enables application upgrades to be performed online
- Code changes installed in the privacy of a new edition
- Data changes are made safely by writing only to new columns or new tables not seen by the old edition
- An editioning view exposes a different projection of a table into each edition to allow each to see just its own columns
- A cross-edition trigger propagates data changes made by the old edition into the new edition’s columns, or (in hot-rollover) vice-versa
GoldenGate plus 2 Optional Approaches to Further Protect Your Applications

Use Oracle Golden Gate
Required

Use Edition-based Redefinition
Optional

Use Oracle Sharding
Alternative
Alternative Platinum Option: Sharding

Highly scalable, fault tolerant architecture for Internet Applications

- Custom Built Application optimized to use shard keys
- Horizontal partitioning of data across independent databases (shards)
  - Each shard holds a subset of the data
  - Can be single-node or RAC or PDB
  - Replicated for high availability
- Shared-nothing architecture:
  - Shards don’t share any hardware (CPU, memory, disk), or software (Clusterware)

A single **logical DB** sharded into N physical Databases

![Diagram of sharding architecture]

- Database
  - Table1
  - Shard1
  - Server1
  - Table1
  - Shard2
  - Server2
  - Table1
  - Shard3
  - Server3
Deployment of a System-Managed SDB with Data Guard

Region Accessibility_Domain1

Clients

Connection Pools

Shard Director shdir1,2

Shard Catalog shardcat

Shardgroup shgrp1

Primaries

Region Accessibility_Domain2

Connection Pools

Shard Director shdir3,4

Shard Catalog shardcat_stdby

Shardgroup shgrp2

HA Standbys

Data Guard Fast-Start Failover
Sharding Configuration Options

Use Sharding with Active Data Guard, RAC or Oracle GoldenGate

- Active Data Guard with Fast-Start Failover

- GoldenGate 'chunk-level' active-active replication with automatic conflict detection/resolution

- Optionally – complement replication with Oracle RAC for server HA

https://www.oracle.com/database/technologies/high-availability/sharding.html
Maximum Availability Architecture (MAA)

Summary & Resources
External Resources

Maximum Availability Architecture

- MAA Home:
  - http://oracle.com/goto/maa

- On-Premise MAA:

- Exadata MAA:

- Cloud MAA:
Provide the best HA, DR and data protection solution for Oracle databases

Continue to enhance validated MAA solutions

Your success is truly our success!!!