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Due to the nature of the product architecture, it may not be possible to safely include all features described in this document without risking significant destabilization of the code.
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INTRODUCTION

Oracle customers are moving Oracle workloads into the Oracle Cloud or onto Engineered Systems at a growingly rapid pace. However, migrating workloads has been a source of challenges for many years. In particular, migrating database workloads from one system to another or into the Cloud is easier said than done.

Based on years of experience migrating Oracle workloads, Oracle has developed Zero Downtime Migration (ZDM). ZDM is Oracle's premier solution for a simplified and automated migration experience, providing zero to negligible downtime for the production system and depending on the migration scenario. ZDM allows you to directly and seamlessly migrate your Oracle Databases to and between any Oracle-owned infrastructure, including Exadata Database Machine On-Premises, Exadata Cloud at Customer (ExaC@C), and Oracle Cloud Infrastructure. Oracle ZDM supports a wide range of Oracle Database versions and, as the name implies, ensures minimal to no production database impact during the migration.

ZDM follows Oracle Maximum Availability Architecture (MAA) principles one and incorporates products such as GoldenGate and Data Guard to ensure High Availability and an online migration workflow that leverages technologies such as the Recovery Manager, Data Pump, and Database Links.

Furthermore, since 21.1, Oracle ZDM has supported Oracle's Autonomous Database as a Cloud Target, allowing customers to move their existing workloads into Oracle's premier database cloud service, leveraging its self-driving, self-securing, and self-repairing capabilities. Oracle ZDM migrates on-premises databases to Oracle Autonomous Transaction Processing and Oracle Autonomous Warehouse, both on Shared and Dedicated offerings.

Starting in 21.2, Oracle ZDM supports Oracle Databases on AWS RDS; This expands ZDM's list of sources and provides customers with a broader choice of migration possibilities.

Now, in release 21.3, Oracle ZDM further expands its support of migrations from AWS RDS sources, enhances its Data Guard support, and adds full cross-platform support for its logical migration workflow.

This technical brief provides an overview of Oracle Zero Downtime Migration 21.3, the latest version, explaining its underlying workflow and how you can use it for efficient and seamless migration of your Oracle Databases.

For more information on Oracle Zero Downtime Migration, please visit ZDM's product website.

1 [Http://www.oracle.com/goto/zdm](Http://www.oracle.com/goto/zdm)
ZERO DOWNTIME MIGRATION

Architecture

Oracle Zero Downtime Migration (ZDM) is the Oracle Maximum Availability Architecture (MAA)-recommended solution to migrate Oracle Databases to the Oracle Cloud. ZDM’s inherent design keeps the migration process as straightforward as possible and ensures the most negligible impact on production workloads. The Source Database to be migrated can be on-premises, on Oracle on AWS RDS, deployed on Oracle Public Cloud Gen 1 or Oracle Cloud Infrastructure. The Target Database deployment can be in a Database Cloud Service on Oracle Cloud Infrastructure (OCI) Virtual Machine, Exadata Cloud Service, Exadata Cloud at Customer, Exadata On-Premises, or Autonomous Database. ZDM automates the entire migration process, reducing the chance of human errors. ZDM leverages Oracle Database-integrated high availability (HA) technologies such as Oracle Data Guard and GoldenGate and follows all MAA best practices that ensure no significant downtime of production environments. Oracle ZDM supports both Physical and Logical Migration workflows.

Database Support and Supported Configurations

Oracle ZDM supports Oracle Database versions 11.2.0.4, 12.1.02, 12.2.0.1, 18c, 19c & 21c. ZDM’s physical migration workflow requires the source and target databases to be in the same database release. Starting with ZDM 21.1, the Logical Migration workflow supports cross-version migration, thus providing an in-flight upgrade while migrating to the Oracle Cloud.

Oracle ZDM supports Oracle Databases hosted on Linux, AIX, and Solaris operating systems. Source Databases can be:

- Single Instance Databases.
- RAC One Node or RAC Databases.

Oracle ZDM supports Oracle Database Enterprise & Standard Edition as Source Databases.

Oracle ZDM allows the source database to be a non-CDB or a container database (CDB) with one or more Pluggable Databases (PDBs). Starting with release 21.1, Oracle ZDM allows non-CDB Databases to be migrated to Pluggable Databases on-the-fly, allowing for total conversion and adding more versatility to the migration workflow.

Migration Paths

ZDM supports on-premises databases to be migrated to a variety of targets:

- Oracle Database Cloud Service
  - Bare Metal & Virtual Machine
- Oracle Exadata Cloud Service
- Oracle Exadata Cloud at Customer
- Oracle Exadata On-Premises
- Oracle Autonomous Database
  - Autonomous Transaction Processing (Dedicated and Shared)
  - Autonomous Data Warehouse (Dedicated and Shared)
Benefits

- **Simple & Efficient**
  - Oracle ZDM automated workflow makes it seamless to move your Oracle Database to the Oracle Cloud. By eliminating the need for manual configurations and operations, Oracle ZDM ensures an error-free and efficient migration to Oracle Cloud or Oracle Engineered systems on-premises in general.

- **Highly Available**
  - Oracle ZDM is Oracle Maximum Availability Architecture compliant; the tight integration with Oracle Database technologies such as Oracle Data Guard and Oracle GoldenGate ensures that your migration completes with zero downtime and no production impact.

- **Flexible**
  - You can directly migrate your Oracle Database to the Oracle Cloud and the Exadata Database Machine On-Premises from various source databases depending on your requirements and business needs.

- **Validation**
  - Oracle ZDM performs extensive checks before and post-migration allows for pausing and resuming your migration tasks if required, and includes an evaluation mode to preempt any issues during your database migration.

- **Cost-Effective**
  - The Oracle ZDM engine is available at no extra cost.
WHAT’S NEW IN ORACLE ZERO DOWNTIME MIGRATION 21.3

Logical Migration Enhancements
- New Target Exadata On-Premises
- Logical Online Cross-Platform Support

Physical Migration Enhancements
- Job Suspension
- GG Microservice Suspension and Configuration Update
- Parallel Schema Migration

Oracle AWS RDS Enhancements
- Migration Advisor Support
- Logical Online Support
- New OCI Targets

Oracle AWS RDS Enhancement
Oracle ZDM 21.3 introduces Pre-Migration Advisor (CPAT) support for Oracle Source Databases on AWS RDS. Customers can also leverage Oracle ZDM Logical Online workflow to migrate Oracle Databases on AWS RDS to the Oracle Cloud. Furthermore, a new array of supported OCI targets are also available in this workflow. Starting with this release, customers can migrate to DBCS, ExaCS, and Autonomous Database.

Logical Online Migration Cross-Platform Support
Starting in release 21.2, Oracle ZDM supports cross-platform migration with the logical offline workflow. Now, in release 21.3, Oracle ZDM provides full support for Logical Online Migration, harnessing the power of Data Pump and GoldenGate to provide a highly available migration to all customers performing a cross-platform migration, either from AIX or Solaris to the Oracle Cloud.
Logical Migration New Target: Exadata

Oracle ZDM 21.3 introduces the capability of using Oracle ZDM Logical Online workflow with Data Pump and GoldenGate to migrate to On-Premises Exadata Targets. This methodology provides a platform for in-flight upgrades, hardware refresh, and cross-platform migration. Usage of Oracle GoldenGate in this workflow requires an On-Premises GoldenGate Hub with a customer-provided GoldenGate license.

Logical Migration Enhancements

- Job suspension → in-flight job pausing and resuming for Logical Migration
- Schema Parallel Migration
- Data Pump auto-retry in case of failure
- GoldenGate microservices in pause and upgrade capabilities

Physical Online Migration Standby Database Support

Starting with ZDM 21.3 you can migrate your Oracle Database leveraging an existing Standby Database. This feature provides less operations at the primary source level, using an existing Standby for target restore process. ZDM will proceed with the rest of the migration workflow using the source primary database, thus minimizing any initial impact on the primary.

Physical Migration Enhancement: Data Guard Broker Support

Oracle ZDM 21.3 introduces the capability of using the Oracle Data Guard Broker during the migration. Oracle ZDM leveraging Data Guard for its physical online workflow, with this new feature, ZDM will maximize its Data Guard integration by using the Broker. For Source Oracle Databases that do not have a Standby Database or are already managed by the Data Guard Broker, ZDM will use the Broker to complement the switch-over process. For Oracle Source Databases that already have a Standby which is not managed by the Broker, ZDM will use the already existing switch-over mechanism.
MIGRATION WORKFLOWS

Physical Migration

- Offline Migration
  - ZDM physical offline migration leverages Oracle Recovery Manager and migrates the database using a backup and restore methodology. Customers can use this method when migrating to Oracle Database Cloud Services Virtual Machines, Exadata Cloud Service, Exadata Cloud at Customer, and Exadata Database Machine On-Premises.

![Figure 9 – Step-by-Step Physical Offline Migration.](image)

Step 1, Download and Configure ZDM. Step 2, ZDM Starts Database Migration. Step 3, ZDM Connects the Source Database to the Backup Location. Step 4, ZDM Orchestrates Transfer of Database Backup Files. Step 5, ZDM Instantiates a Target Database. Step 6, ZDM Switches Over. Step 7, ZDM Finalizes the Migration Process.

- Online Migration
  - ZDM physical online migration leverages Oracle Recovery Manager and Oracle Data Guard. Customers should use this method when a highly available migration and minimizing any possible impact is a priority. Customers can use this method to migrate to Oracle Database Cloud Services Virtual Machines, Exadata Cloud Service, Exadata Cloud at Customer, and Exadata Database Machine On-Premises.

![Figure 10 – Step-by-Step Physical Online Migration](image)

Step 1, Download and Configure ZDM. Step 2, ZDM Starts Database Migration. Step 3, ZDM Connects the Source Database to the Backup Location. Step 4, ZDM Orchestrates Transfer of Database Backup Files. Step 5, ZDM Instantiates a Standby Database. Step 6, ZDM Synchronizes Primary and Standby. Step 7, ZDM Switches Over & Swaps Roles. Step 8, ZDM Finalizes the Migration Process.
Online Migration with Direct Data Transfer

- This feature allows users to avoid using an intermediate store for backups (normally NFS or the OCI Object Storage). ZDM leverages either active database duplication (for 11.2 databases) or restore from service (for 12+ databases). Customers can use this method to migrate to Oracle Database Cloud Services Virtual Machines, Exadata Cloud Service, Exadata Cloud at Customer, and Exadata Database Machine On-Premises.

Figure 11 – Step-by-Step Physical Online Migration with Direct Data Transfer

Step 1, Download and Configure ZDM. Step 2, ZDM Starts Database Migration. Step 3, ZDM Connects the Source Database to the Backup Location. Step 4, ZDM Orchestrates Direct Data Transfer. Step 5, ZDM Instantiates a Standby Database. Step 6, ZDM Synchronizes Primary and Standby. Step 7, ZDM Switches Over & Swaps Roles. Step 8, ZDM Finalizes the Migration Process.
Logical Migration
Oracle ZDM 21c introduced logical migration as part of its migration methodologies. The logical migration workflow leverages Oracle Data Pump, Database Links, and GoldenGate; customers have four workflow possibilities tailoring to their scenarios and needs.

Logical Offline Migration

- Offline Migration with Data Pump and Backup Location
  - ZDM logical offline migration with Data Pump and Backup Location offers customers a simple yet efficient method to migrate their databases to the Oracle Cloud. The backup location can be the Object Storage for OCI migrations and NFS or the Recovery Appliance for Exadata Cloud at Customer. This method supports source Oracle Databases on AWS RDS.

Figure 12 – Step-by-Step Logical Offline Migration with Data Pump and Backup Location
Step 1, Download and Configure ZDM. Step 2, ZDM Performs Validations. Step 3, ZDM Connects to Backup Location. Step 4, ZDM Exports via Data Pump from Source to Backup Location. Step 5, ZDM Imports Data Dump Files from Backup Location to Target. Step 6, ZDM Instantiates Target Database. Step 7, ZDM Switches Over and Finalizes the Migration Process.

- Offline Migration with Data Pump and Database Links
  - ZDM offline logical migration can also leverage Database Links to establish a direct connection between the source database and the target database in the Oracle Cloud, thus eliminating the need for a backup location. This methodology is recommended only for source Databases smaller than 100 Gb.

Figure 13 – Step-by-Step Logical Offline Migration with Data Pump and Database Links.
Step 1, Download and Configure ZDM. Step 2, ZDM Performs Validations. Step 3, ZDM Connects Source and Target via Database Link. Step 4, ZDM Imports Data Pump files from Source to Target. Step 5, ZDM Validates Target Database. Step 6, ZDM Switches Over and Finalizes the Migration Process.
Logical Online Migration

- **Online Migration with Data Pump, GoldenGate, and Database Links**
  - Oracle ZDM leverages a GoldenGate hub that will help synchronize both the source and target database while providing a highly available migration. Database Links are used for a direct connection between source and database target, while the instantiation of the target database is done via Data Pump.

  ![Diagram](image1.png)

  **Figure 14 – Step-by-Step Logical Online Migration with Data Pump, GoldenGate, and Database Links.**
  Step 1, Download and Configure ZDM. Step 2, ZDM Starts Database Migration. Step 3, ZDM Connects to Source and Target via Database Link. Step 4, ZDM Configures GoldenGate and Captures Source Transactions. Step 5, ZDM Imports via Data Pump from Source to Target. Step 6, ZDM Configures GoldenGate and Starts Applying Changes. Step 7, ZDM Switches Over and Finalizes the Migration Process.

- **Online Migration with Data Pump, GoldenGate, and Backup Location**
  - Customers can also leverage a designated backup location instead of using a direct Database Link between the source and the target database. Migration to OCI-based databases will use the Object Store. In contrast, migrations to Exadata Cloud at Customer can choose between an external NFS filer or the Recovery Appliance as a backup location.

  ![Diagram](image2.png)

  **Figure 15 – Step-by-Step Logical Online Migration with Data Pump, GoldenGate, and Backup Location**
  Step 1, Download & Configure ZDM. Step 2, ZDM Starts Database Migration. Step 3, ZDM Connects to Source, Target, and Backup Location. Step 4, ZDM Configures GoldenGate and Captures Source Transactions. Step 5, ZDM Exports via Data Pump from Source to Backup Location. Step 6, ZDM Imports DataDump Files from Backup Location to Target. Step 7, ZDM Configures GoldenGate and Starts Applying changes. Step 8, ZDM Switches Over and Finalizes the Migration Process.
SUMMARY

Oracle Zero Downtime Migration is Oracle's premier and automated solution for database cloud migration. Oracle ZDM provides customers a direct and seamless migration for Oracle Databases to Oracle Cloud and Exadata Database Machine, supporting a wide range of Oracle Database versions as sources and Oracle Database Cloud Services as targets. Customers have a wide array of Source Oracle Database for their migration; Oracle ZDM supports Oracle databases on Solaris, Linux, AIX, and AWS RDS.

Oracle ZDM supports Standard Edition and Enterprise Edition Oracle Databases, offering different migration approaches ranging from offline backup and restore, over Data Pump and Database Links-based migrations, to using technologies such as Data Guard and GoldenGate for physical as well as logical migration workflows. Customers can leverage features like ZDM's Physical Direct Data Transfer to avoid using a backup location and thus achieve a faster and more efficient migration.

Migration to the Oracle Cloud can be achieved in as little as six simple steps for offline migrations and eight steps for online-based migrations. In any scenario, Oracle ZDM provides a Maximum Availability Architecture-compliant migration, ensuring high availability, data protection, and disaster recovery for your migration journey to the Oracle Cloud.

Oracle ZDM offers fleet-level migrations, catering to all single instance, Oracle RAC and RAC One Node database migration scenarios, making it the Best-In-Class solution for moving your databases to the Oracle Cloud and Exadata. It provides:

- A Wide Array of Migration Sources and Targets
- Multiple Migration Workflows
- Best-in-Class Features & Functionality
- Fully Automated Migrations
- Cost-effective migration support

For more information, step-by-step guides, and product documentation, please visit the Oracle Zero Downtime Migration website under: [www.oracle.com/goto/zdm](http://www.oracle.com/goto/zdm).