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**Cloud**

# Oracle Zero Downtime Migration

Introduction and Technical Overview

WHITE PAPER / NOVEMBER 2019

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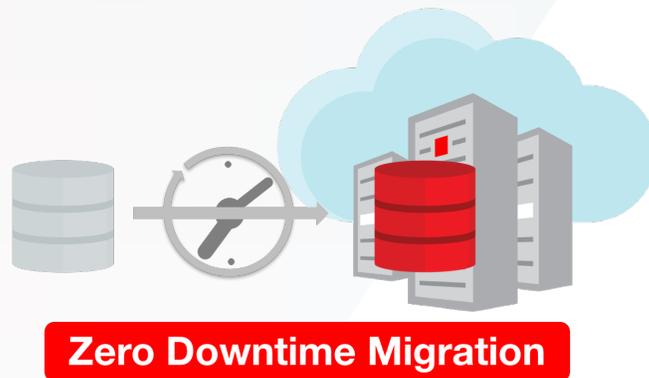
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## INTRODUCTION

Oracle Database is the best enterprise database that offers the highest levels of performance, availability, scalability and security. It also offers the most flexible deployment options – whether on-premises, in the public cloud leveraging Oracle Infrastructure<sup>1</sup> (OCI), or in a Cloud at Customer platform leveraging Exadata Cloud at Customer<sup>2</sup> (ExaCC), in your own data center.

Oracle Zero Downtime Migration (ZDM) is a software solution that allows you to directly and seamlessly migrate your on-premises Oracle Databases to the Oracle Cloud – whether in OCI or ExaCC. Oracle ZDM supports a wide range of Oracle Database versions, and – as the name implies, it ensure that there is minimal to no production database impact during the migration, following the principles of Oracle Maximum Availability Architecture<sup>3</sup>.

This whitepaper is a technical overview of Oracle Zero Downtime Migration, explaining its underlying workflow and how you can use it to efficiently migrate your on-premises databases to the Oracle Cloud.

<sup>1</sup> <https://www.oracle.com/database/cloud-services.html>

<sup>2</sup> <https://www.oracle.com/exadata>

<sup>3</sup> <http://oracle.com/goto/maa>

## ZERO DOWNTIME MIGRATION

Oracle Zero Downtime Migration (ZDM) is Oracle Maximum Availability Architecture (MAA)-recommended solution to migrate Oracle Databases to the Oracle Cloud. ZDM has been designed with the goals of keeping the migration process as simple as possible and ensuring least impact on production workloads. The source databases to be migrated can be on-premises or deployed on Oracle Public Cloud Gen 1. The target databases may be deployed as Database Cloud Service on Oracle Cloud Infrastructure (OCI) Bare Metal, Virtual Machine, Exadata Cloud Service, or Exadata Cloud at Customer. ZDM automates the entire process of migration, reducing the chance of human errors. ZDM leverages Oracle Database-integrated high availability (HA) technologies such as Oracle Data Guard and follows all MAA best practices that ensures zero to no downtime of production environments.

### Database Support and Supported Configurations

Oracle ZDM supports the following Oracle Database versions:

- 11.2.0.4
- 12.1.0.2
- 12.2.0.1
- 18c
- 19c

The source and target databases should be in the same database version. Oracle ZDM supports Oracle Databases hosted on Linux operating systems. The source database can be a single instance database migrating to a single instance or a RAC database, or it can also be a RAC One Node / RAC database, migrating to a RAC database.

Oracle ZDM supports Enterprise & Standard Edition Oracle Databases as source databases. Enterprise Edition Databases are migrated leveraging Oracle Data Guard; Standard Edition Databases are migrated in an offline manner using a backup and restore methodology.

Oracle ZDM allows for the source database to be a non-CDB or a container database (CDB) with one or more Pluggable Databases (PDBs). If the source Database is a non-CDB, it will be migrated as a non-CDB. In case of a CDB with one or more PDBs, ZDM migrates it to a CDB with the same set of PDBs as in the source CDB.

### Migration Paths

ZDM supports on-premises databases to be migrated to:

1. Oracle Database Cloud Service Bare Metal
2. Oracle Database Cloud Service Virtual Machine
3. Exadata Cloud Service
4. Exadata Cloud at Customer

In order to support those migrations, ZDM leverages features and functionality from Oracle's Fleet Patching and Provisioning (FPP) framework<sup>4</sup>, such as FPP's job scheduler capabilities, giving you full control to schedule, pause and resume any database migration task. ZDM also leverages FPP's evaluation mode to validate the migration process and detect possible failure conditions, before the migration starts.

ZDM includes audit capabilities during and post migration, also, ZDM distributes its migration process in distinctive phases, allowing for users to customize the workflow, adding user action scripts at any desired step.

<sup>4</sup> [www.oracle.com/goto/fpp](http://www.oracle.com/goto/fpp)

## MIGRATION WORKFLOW

ZDM performs a zero downtime migration in eight simple steps, which can be scheduled and monitored as needed. The following section provides details on each of these steps.

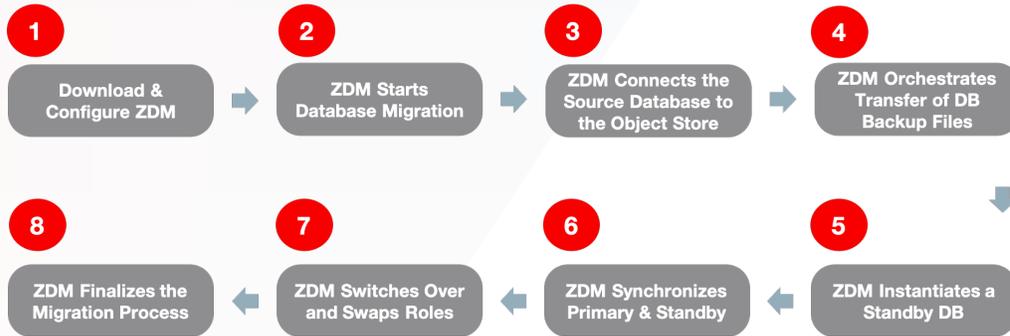
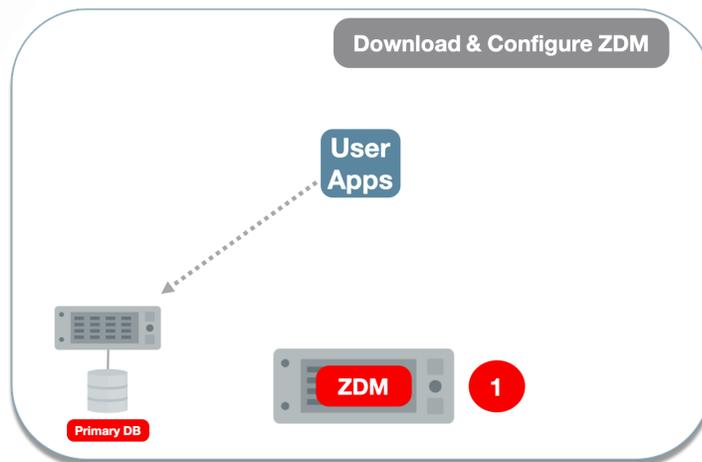


Figure 1: Zero Downtime Migration - Overview of Steps

### 8-Step Database Migration

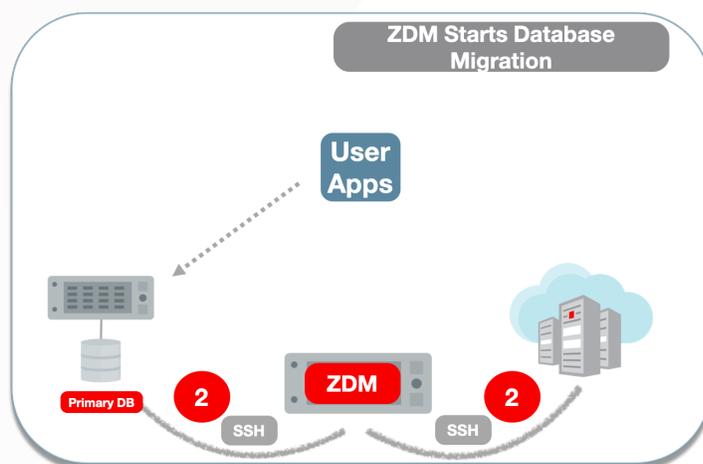
#### DOWNLOAD AND CONFIGURE ZDM

1. Download ZDM from [www.oracle.com/goto/zdm](http://www.oracle.com/goto/zdm) and configure it.
  - a. ZDM requires Linux 7 (or above) and should be configured on a separate server.



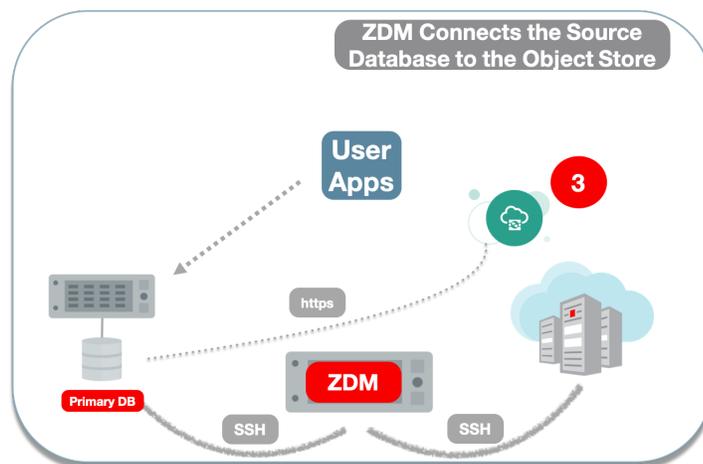
## ZDM STARTS DATABASE MIGRATION

2. Fill in the ZDM template file and start the database migration process using the `zdmcli migrate database` command.
  - a. As a best practice, it is recommended to run the `zdmcli migrate database` command, with the `-eval` flag. This will perform a dry-run of the migration. Evaluation mode validates the migration process and allows you to perform necessary corrective steps prior to executing the actual migration steps.
  - b. Upon executing the `zdmcli migrate database` command, ZDM will connect to the source/primary database and the target Oracle Database Cloud Service with the provided SSH keys.



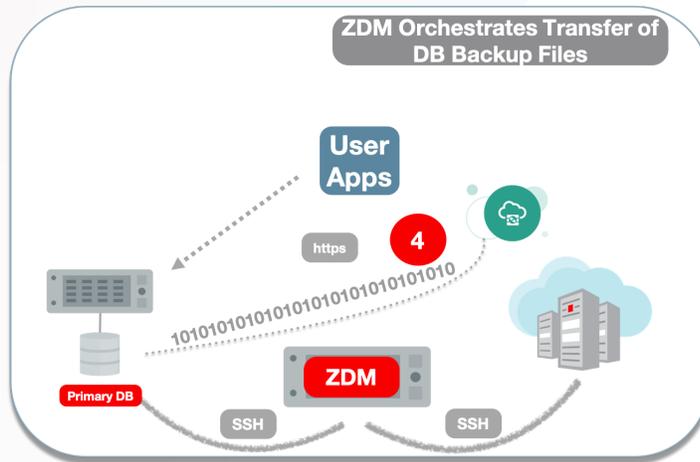
## ZDM CONNECTS THE SOURCE DATABASE TO THE OBJECT STORE

3. ZDM proceeds to establish connectivity between the source/primary database and the Oracle Object Store in the Oracle Cloud. Customers migrating to Exadata Cloud at Customer, can use local NFS Storage or the Zero Data Loss Recovery Appliance instead of the Object Store.



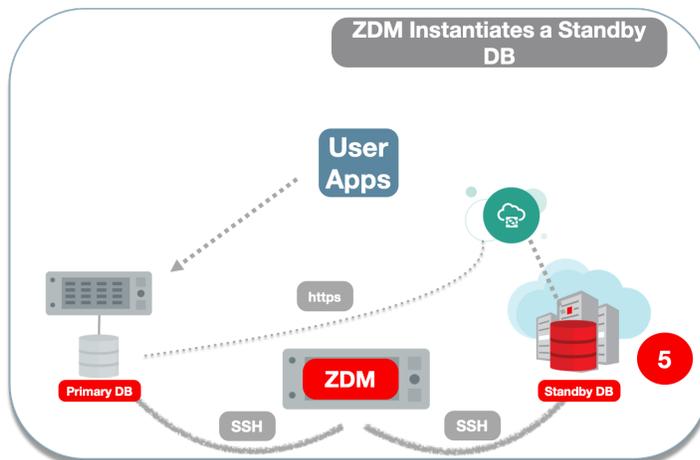
#### ZDM ORCHESTRATES TRANSFER OF DB BACKUP FILES

4. ZDM orchestrates transfer of all database backup files from the source/primary database to the Object Store.



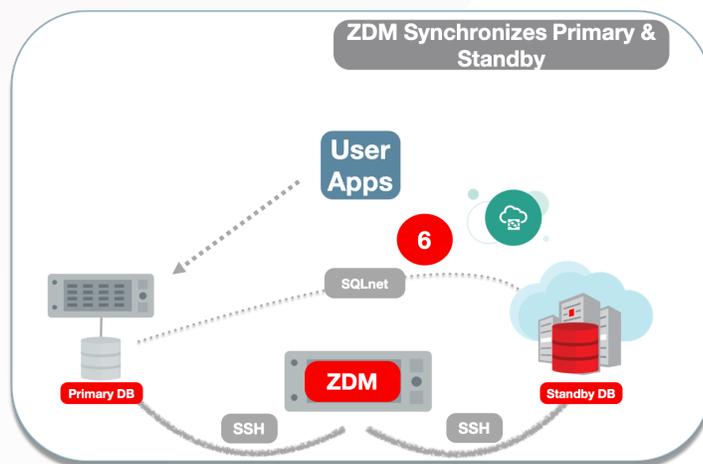
#### ZDM INSTANTIATES A STANDBY DATABASE

5. ZDM instantiates a Data Guard Standby Database using the backup files that were transferred in the previous step.



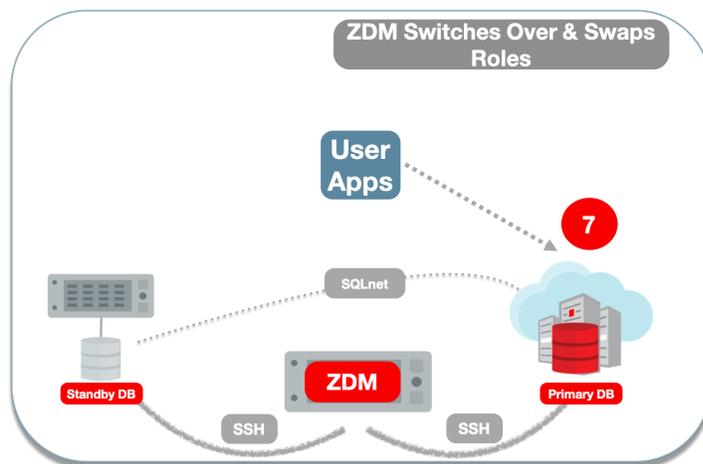
## ZDM SYNCHRONIZES PRIMARY AND STANDBY

6. ZDM sets up Oracle Net Services connectivity between the source and target, and completes setting up the Data Guard configuration such that the source/primary database is the primary database for the standby database that was just created. Afterward, ZDM proceeds to verify that the Standby Database is fully in sync with the Primary Database.



## ZDM SWITCHES OVER & SWAPS ROLES

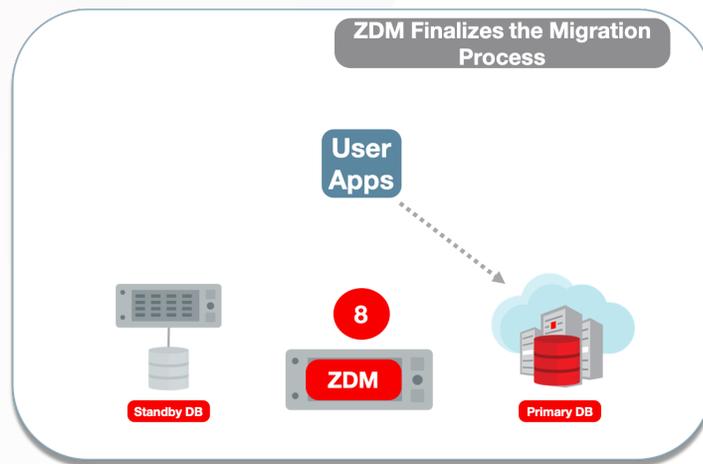
7. ZDM then performs a Data Guard switchover and transitions the role of the databases, resulting in the source database to become the standby database and the target database in the Oracle Cloud to assume the role of the primary database. Automatic application switchover can be ensured with proper configuration as detailed in Oracle Zero Downtime Migration documentation<sup>5</sup>.



<sup>5</sup> <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/19.2/zdmug/preparing-for-database-migration.html#GUID-E469DD80-6C5A-4105-A08D-8A976097F560>

## ZDM FINALIZES THE MIGRATION PROCESS

8. ZDM finalizes the migration process, terminates Data Guard connectivity between the source and the target, and performs necessary cleanup operations at the source and target environments. The user can also request ZDM to pause before Migration Completion, controlling when Data Guard synchronization between the primary and the standby will complete.



## TECHNICAL CONSIDERATIONS

### ZDM Setup

Oracle ZDM can be installed on a standalone server running Oracle Linux 7 only. The node on which ZDM is set up, referred to as the ZDM service node, should not have Grid Infrastructure installed and running on it.

### Connectivity

In order to establish connectivity between the ZDM service node and the source and target server, the following steps need to be ensured:

1

Authentication Key pairs must be available (without a passphrase) for the ZDM user on the ZDM service host

2

Private key file and associated files must be renamed to the required values as per the ZDM product documentation

```
ZDM_installed_user_home/.ssh/id_rsa to ZDM_installed_user_home/.ssh/ZDM_service_node_name.ppk
```

3

Transfer contents of file  
ZDM\_installed\_user\_home/.ssh/id\_rsa.pub  
to the file  
opc\_user\_home/.ssh/authorized\_keys

Specific dependencies for this step are described in depth in the Zero Downtime Migration product documentation.

4

Server names for source and target database must be resolvable from the Zero Downtime Migration service node

5

Port 22 in both Source and Target must accept SSH connections from the Zero Downtime Migration service node

Once the above has been ensured, the last step is to test connectivity between the Zero Downtime Migration Service node and both, the source and target servers. The next step is to configure connectivity between the source and target servers. This can be done in either of the following two ways:

A

Connection using SCAN

B

Connection by setting up a SSH tunnel

For information on how to pursue either Option A or Option B and step by step instructions on how to generate a private SSH key without a passphrase, please refer to the Zero Downtime Migration product documentation<sup>6</sup>.

### Transparent Data Encryption Configuration

Transparent Data Encryption (TDE) is required as part of the migration process. This is due to the fact that all Oracle Cloud-based Databases are encrypted with TDE by default. Zero Downtime Migration can handle un-encrypted Databases on-premises and migrate them to encrypted Databases on the Oracle Cloud. Please refer to the Zero Downtime Migration Documentation<sup>7</sup> for specific cases when encryption at source is not required. For Oracle 12c Release 2 or later Databases, the source database must have the TDE wallet configured before any migration jobs take place.

### Source and Target Database Preparation

Oracle ZDM requires the source and target databases to meet the following prerequisites,:

1. The Source Database must be in archive log mode.
2. TDE wallet must be configured on all Oracle Database 12c Release 2 or later databases.
3. The wallet status must be “open” and Wallet Type should be AUTOLOGIN (preferred type) or Password.
4. For Multitenant DBs, the wallet must be open and master key must be set on all PDBs and the CDB.
5. For all Oracle RAC Databases, SNAPSHOT CONTROLFILE must point to a shared location on all nodes.
6. Port 22 on source and target nodes must allow incoming connections from each other.
7. SCAN listener ports on source and target nodes must allow incoming connections from each other.
8. In order to preserve the source database Recovery Time Objective (RTO) and Recovery Point Objective (RPO) during the migration, the existing RMAN backup strategy should be maintained. Note that during the migration a dual backup strategy will be in place; the existing one and the one used by ZDM. Avoid having two RMAN backup jobs running simultaneously (the existing one and the one initiated by ZDM). If archive logs were to be deleted on the source database and these archive logs are needed by ZDM to instantiate the target cloud database, these files should be restored by the user in order for ZDM to be able to continue the migration process.

<sup>6</sup> <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/19.2/zdmug/preparing-for-database-migration.html#GUID-4AA4FE49-52FC-4149-A5F9-123662198303>

<sup>7</sup> <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/19.2/zdmug/zero-downtime-migration-encryption-requirements.html#GUID-BE79A11D-3F15-4DAC-9B5B-27B691AB1265>

## Target Specific Preparation

ZDM supports migration to Oracle Cloud Infrastructure Bare Metal/Virtual Machines, Exadata Cloud at Customer and Exadata Cloud Services. Specific preparation tasks must take place according to the requirements of the target database cloud service. Detailed steps can be found in the Oracle Zero Downtime Migration product documentation<sup>8</sup>.

## Migration Customization

Prior to the migration, users have the ability to customize specific jobs for each operational phase of the zero downtime migration, both at the source and the target level. Four actions can be performed in order to customize a migration job; 1) Register an Action Plug-in, 2) Create an Action Template, 3) Update an Action Plug-in and 4) Associate an Action Template with a Migration Job. Please refer to Oracle Zero Downtime Migration product documentation for further details<sup>9</sup>.

## Benefits of Oracle Zero Downtime Migration

- Simple & Efficient
  - Oracle ZDM automated workflow makes it seamless to move your Oracle on-premises database to the Oracle Cloud. By eliminating the need for manual configurations and operations, Oracle ZDM ensures an error-free and efficient migration to the Oracle Cloud.
- Highly Available
  - Oracle ZDM is Oracle Maximum Availability Architecture compliant, the tight integration with Oracle Database technologies such as Oracle Data Guard ensures that your migration completes with zero downtime and no production impact.
- Flexible
  - You can directly migrate your Oracle Database to the Oracle Cloud from various source databases into different target cloud deployments depending on your requirements and business needs.
  - Oracle ZDM performs extensive checks prior and post migration; allows for pausing and resuming your migration tasks if required; provides rollback capabilities and includes an evaluation mode to preempt any issues during your database migration.
- Cost Effective
  - Oracle ZDM is available at no extra cost.

<sup>8</sup> <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/19.2/zdmug/preparing-for-database-migration.html#GUID-E8A2DD5F-B447-465F-BE2E-55E79FFD092D>

<sup>9</sup> <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/19.2/zdmug/preparing-for-database-migration.html#GUID-193B52E9-A094-472A-9204-3A77EF5137E7>

## CONCLUSION

Oracle Zero Downtime Migration is Oracle's premier and automated tool for database cloud migration. Oracle ZDM provides customers a direct and seamless migration for their on-premises Oracle Databases to the Oracle Cloud, supporting a wide range of Oracle Database versions as sources and Oracle Database Cloud Services as targets.

Oracle ZDM supports Enterprise Edition Oracle Databases, offering a migration approach leveraging Oracle Data Guard High Availability. Oracle ZDM also supports Standard Edition Oracle Databases, offering an offline migration approach based on a backup and restore focused methodology.

Eight simple steps allow customers to migrate their on-premises databases in a simple and efficient fashion, download and configuration of the ZDM software; start of the database migration process; establishing connectivity to the backup location of choice (Object Store for OCI and NFS Storage or Zero Data Loss Recovery Appliance for Exadata Cloud at Customer); transferring database backup files to the backup location of choice; instantiating a standby database in the Oracle Cloud; synchronizing primary and standby databases; performing a controlled switch over & swapping database roles; and finalizing all migration tasks and associated cleanups.

Oracle ZDM is Maximum Availability Compliant, 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 your single instance database, RAC and RAC one node databases.

Finally, Oracle ZDM offers the most cost effective solution for all your Oracle Database Cloud migration needs.

For more information see the Oracle Zero Downtime Migration product documentation which can be found in <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/>

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White Paper **Oracle Zero Downtime Migration** Oracle ZDM - Database Cloud Migration Oracle Zero Downtime Migration Oracle Zero Downtime Migration

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