

Oracle Zero Downtime Migration (ZDM)

Step-by-Step Guide – Logical Migration and In-Flight Upgrade from On-Premises to DBCS and ExaCS

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Figure 1. Oracle Zero Downtime Migration Logo comprising of a Database, a Clock with an arrow pointing to a Database deployed in the Cloud

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Figure 1. Oracle Zero Downtime Migration Logo comprising of a Database, a Clock with an arrow pointing to a Database deployed in the Cloud

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 depending on the migration scenario. ZDM allows you to directly and seamlessly migrate your on-premises 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) principles¹ 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.

This technical brief is a step-by-step guide for migrating your on-premises Oracle Databases to the Oracle Cloud with Zero Downtime Migration's new Logical workflow. The scenario used for this migration comprises a Source Database running on Compute via Marketplace to emulate an On-Premises environment and a Target Database running on Oracle Cloud Infrastructure DBCS Virtual Machines; The base process is the same for a Target Database running on Oracle Cloud Infrastructure Exadata Cloud Service.

Oracle ZDM will run on a separate node and connect to both Source and Target to perform the migration. This guide will cover all requirements related to installing the Oracle ZDM service host, the Source Database to be migrated, the Target Database recipient of the migration process, the backup and networking used. The migration process will be dissected and done in a step-by-step fashion. This guide will answer the most frequently asked questions regarding the product and the overall migration process.

The Source Database will be an 11.2.0.4 Oracle Database, and the Target Database will be a 19c Oracle Database. This guide will cover the migration process while providing an in-flight upgrade of the Source Database.

For more information on Oracle Zero Downtime Migration, please visit ZDM's product website.²

¹ <http://oracle.com/goto/maa>

² [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 in mind the migration process as straightforward as possible to ensure the most negligible impact on production workloads. The Source Database to be migrated can be on-premises, 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, 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. This technical brief covers a step-by-step guide for the Logical Migration Workflow leveraging the Object Storage as a backup location.

The Logical Migration Workflow in ZDM has two flavors, Offline and Online. Offline migration leverages Data Pump for data transfer and target instantiation. Online Migration also leverages Data Pump for the same purposes described above but also leverages Oracle GoldenGate for synchronization purposes and to preserve the online portion of the migration process. For offline and online workflows, ZDM takes care of each one of the steps and automates everything.

A standard logical offline migration will take the following steps:

1. Download and Configure ZDM.
2. ZDM Performs Validations.
3. ZDM Connects to Backup Location
4. ZDM Exports Via Data Pump from Source to Backup Location.
5. ZDM Imports Data Dump Files from Backup Location to Target.
6. ZDM Instantiates Target Database.
7. ZDM Switches Over Finalizes the Migration Process.

A standard logical online migration will take the following steps:

1. Download & Configure ZDM.
2. ZDM Starts Database Migration.
3. ZDM Connects to the Source, Target, and Backup Location.
4. ZDM Configures GoldenGate and Captures Source Transactions.
5. ZDM Exports via Data Pump from Source to Backup Location.
6. ZDM Imports Data Dump Files from Backup Location to Target.
7. ZDM Configures GoldenGate and Starts Applying changes.
8. ZDM Switches Over and Finalizes the Migration Process.

Supported Configurations

Oracle ZDM supports Oracle Database versions 11.2.0.4, 12.1.0.2, 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 21c and introducing the Logical Migration workflow, ZDM now supports database cross-version migration, thus providing an in-flight upgrade while migrating to the Oracle Cloud.

Oracle ZDM supports Source Oracle Databases hosted on Linux, Solaris, and AIX operating systems. Oracle ZDM supports single-instance databases, Oracle RAC One Node databases, or Oracle RAC databases as sources. Oracle ZDM supports Oracle Database Enterprise & Standard Edition as Source and Target Databases.

Zero Downtime Migration Service Host

Zero Downtime Migration Service Host Requirements

Oracle Zero Downtime Migration installation must take place on a separate host, which must fulfill the following requirements:

- Linux host running on Oracle 7 (must be this OS version).
- 100 GB of free storage space. This space is required for all the logs that ZDM will generate.
- A `zdm` group and a `zdmuser` as part of this group.
- The following packages must be installed:
 - `glibc-devel`
 - `expect`
 - `unzip`
 - `libaio`
 - `oraclelinux-developer-release-el7`
- All hostnames and IP addresses to be used must be present as entries in the `/etc/hosts` file.

For more information on the ZDM Service Host requirements, please refer to Oracle ZDM's product documentation, specifically the "Setting Up Zero Downtime Migration Software" section.

- <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

The ZDM software can be:

- Installed manually on-premises.
- Installed manually on OCI.

This Step-by-Step Guide will cover the manual installation of the ZDM Service Host, including a thorough description of all necessary instructions about the deployment and configuration.

ZDM Service Host Installation

Log in to the ZDM Service Host as root user and follow the steps described here.

First, create a new group, user, and the needed directories as described in the code excerpt below:

```
[root@zdmhost]# groupadd zdm
[root@zdmhost]# useradd zdmuser -g zdm
[root@zdmhost]# mkdir -p /home/zdmuser/zdminstall
[root@zdmhost]# mkdir /home/zdmuser/zdmhome
[root@zdmhost]# mkdir /home/zdmuser/zdmbase
[root@zdmhost]# chown -R zdmuser:zdm /home/zdmuser/
```

Then, proceed to install the required software packages; as root user, follow the code excerpt below:

```
[root@zdmhost]# yum -y install \
glibc-devel \
expect \
unzip \
libaio \
oraclelinux-developer-release-el7
[root@zdmhost]# yum list installed glibc-devel expect unzip libaio oraclelinux-
developer-release-el7
```

Download ZDM binaries to /home/zdmuser/zdminstall from www.oracle.com/database/technologies/rac/zdm-downloads.html. Change the owner of the zip file to zdmuser. As root user, follow the code excerpt below:

```
[root@zdmhost]# cd /home/zdmuser/zdminstall
[root@zdmhost zdminstall]# chown zdmuser:zdm /home/zdmuser/zdminstall/zdm.zip
```

Install the ZDM software. As zdmuser, follow the code excerpt quoted below:

```
[root@zdmhost zdminstall]# su - zdmuser
[zdmuser@zdmhost ~]$ echo "ORACLE_HOME=/home/zdmuser/zdmhome; export ORACLE_HOME" >>
~/bashrc
[zdmuser@zdmhost ~]$ echo "ORACLE_BASE=/home/zdmuser/zdmbase; export ORACLE_BASE" >>
~/bashrc
[zdmuser@zdmhost ~]$ echo "ZDM_BASE=\$ORACLE_BASE; export ZDM_BASE" >> ~/bashrc
[zdmuser@zdmhost ~]$ echo "ZDM_HOME=/home/zdmuser/zdmhome; export ZDM_HOME" >>
~/bashrc
[zdmuser@zdmhost ~]$ echo "ZDM_INSTALL_LOC=/home/zdmuser/zdminstall; export
ZDM_INSTALL_LOC" >> ~/bashrc
[zdmuser@zdmhost ~]$ cat ~/bashrc
ORACLE_HOME=/home/zdmuser/zdmhome; export ORACLE_HOME
ORACLE_BASE=/home/zdmuser/zdmbase; export ORACLE_BASE
ZDM_BASE=\$ORACLE_BASE; export ZDM_BASE
ZDM_HOME=/home/zdmuser/zdmhome; export ZDM_HOME
ZDM_INSTALL_LOC=/home/zdmuser/zdminstall; export ZDM_INSTALL_LOC
[zdmuser@zdmhost ~]$ source ~/bashrc
[zdmuser@zdmhost ~]$ cd /home/zdmuser/zdminstall/
[zdmuser@zdmhost zdminstall]$ unzip zdm.zip
[zdmuser@zdmhost zdminstall]$ cd zdm
-- Proceed to runZDM's installation script zdmuser:
[zdmuser@zdmhost zdm]$ ./zdminstall.sh setup \
oraclehome=$ZDM_HOME \
oraclebase=$ZDM_BASE \
```

```
ziploc=./zdm_home.zip -zdm
```

Start ZDM and check the status. As `zdmuser`, follow the code excerpt below:

```
[zdmuser@zdmhost zdm]$ $ZDM_HOME/bin/zdmservice start
```

Return code is 0

Server started successfully.

```
[zdmuser@zdmhost zdm]$ $ZDM_HOME/bin/zdmservice status
```

```
-----  
Service Status  
-----
```

```
Running:           true  
Transferport:  
Conn String:      jdbc:mysql://localhost:8897/  
RMI port:         8895  
HTTP port:        8896  
Wallet path:      /home/zdmuser/zdmbase/crsdata/zdmhost/security
```

ZDM Service Host Port Requirements

Please find a simplified table with the ports required for communication between the Zero Downtime Migration service host and the Source and Target Database servers.

Port Requirements for ZDM Service Host

- **Purpose:** SSH
 - **Port:** 1, 22
 - **Protocol:** TCP
- **Purpose:** SQL*NET
 - **Port:** 1521, 2484 or a DB Scan listener
 - **Protocol:** TCP
- **Purpose:** OCI & GoldenGate REST Endpoint
 - **Port:** 443
 - **Protocol:** HTTP

You can find more information on the Oracle Zero Downtime Migration documentation section “*Configuring Required Connections.*”

- <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Source Database

Source Database Requirements

ZDM supports Oracle Database 11g release 2 (11.2.0.4) or later versions. Follow these recommendations before starting the migration.

- Apply all recommended/required OGG and RDBMS patches; an updated list of this information can be found at:
 - Oracle ZDM Product Documentation section: “Source Database Prerequisites for Logical Migration”
 - <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>
 - Oracle GoldenGate – Oracle RDBMS Server Recommended Patches (Doc ID 1557031.1)
 - <https://support.oracle.com/rs?type=doc&id=1557031.1>
 - Latest GoldenGate/Database (OGG / RDBMS) Patch recommendations (Doc ID 2193391.1)
 - <https://support.oracle.com/rs?type=doc&id=2193391.1>
- Enable and set the following:
 - ARCHIVELOG mode
 - FORCE LOGGING
 - Enable database minimal supplemental logging
 - Set STREAMS_POOL_SIZE to at least 2GB
 - Follow all the above and other requirements as per:
 - “Source Database Prerequisites for Logical Migration”:
 - <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>
 - “Integrated Extract / Replicat and STREAMS_POOL_SIZE”
 - <https://support.oracle.com/epmos/faces/DocumentDisplay?id=2078459.1>
- Ensure Row Uniqueness by following:
 - “Ensuring Row Uniqueness in Source and Target Tables”:
 - <https://docs.oracle.com/en/middleware/goldengate/core/21.3/index.html>
- If the source database is configured with MAX_STRING_SIZE=STANDARD, set the same for the target database.
- Follow all Oracle GoldenGate Performance Guidelines as per:
 - “Oracle Zero Downtime Migration – Logical Migration Performance Guidelines”
 - <https://www.oracle.com/a/tech/docs/zdm-gg-performance.pdf>
- Create all relevant users for GGADMIN in the source database by following:
 - “Additional Logical Migration Prerequisites”
 - <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Source Database Port Requirements

- **Purpose:** SSH
 - **Port:** 22
 - **Protocol:** TCP
- **Purpose:** SQL*NET
 - **Port:** 1521, 2484 or a DB Scan listener
 - **Protocol:** TCP
- **Purpose:** Database Backup Store. OCI OSS
 - **Port:** 443
 - **Protocol:** HTTP

You can find more information on the Oracle Zero Downtime Migration documentation section “*Configuring Required Connections.*”

- <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Target Database

Target Database Requirements

Zero Downtime Migration will migrate the Source Database to an Oracle Cloud Infrastructure database. This step-by-step guide covers the basics of migrating to a database on DBCS or Exadata Cloud Service.

Create a placeholder database on the Target Cloud service before starting the migration process. This placeholder Target Database must comply with the following requirements:

- **Sizing:** please ensure that the shape chosen will suffice for the Source Database sizing and any future increment in size.
- **Version:** the Target Database must be of the same version or higher than the Source Database version. Migration to a lower version database is not supported.
- **Character set:** the character set on the Source and Target Database must be the same.
- **Database time zone:** the database time zone on the Target Database must be equal to or higher than the Source Database time zone.
- **SSL/TLS:** for Target Databases configured to use SSL/TLS, store the wallet containing the TLS authentication certificates in the correct location on the GoldenGate hub:
 - `/u02/deployments/deployment_name/etc`

Please log in to your Oracle Cloud Account and access the Database systems tab by clicking on the Bare Metal, VM, and Exadata Menu. Please proceed to select the appropriate values regarding: Compartment, DB System name, Availability domain, shape, etc.

Log in to the Target Database via SSH and verify that the database time zone is equal to or higher than the Source Database.

-- TARGET Time zone check

```
SQL> SELECT * FROM v$timezone_file;
```

FILENAME	VERSION	CON_ID
timezlrq_35.dat	35	0

-- SRVCTL Configuration Show current settings on Target

```
[oracle@target ~]$ srvctl config database -d TARGET_DB -a
```

Database unique name: TARGET_DB_nrtlwq

Database name: TARGET_DB

Oracle home: /u01/app/oracle/product/19.0.0.0/dbhome_1

Oracle user: oracle

Spfile: +DATA/TARGET_DB/PARAMETERFILE/spfile.269.1071901813

Password file:

Domain: publicsubnet.vcnjpanetchning.oraclevcn.com

Start options: open

Stop options: immediate

Database role: PRIMARY

Management policy: AUTOMATIC

Server pools:

Disk Groups: RECO,DATA

Mount point paths:

Services:

Type: SINGLE

Database is enabled

Database is individually enabled on nodes:

Database is individually disabled on nodes:

OSDBA group: dba

OSOPER group: dbaoper

Database instance: TARGET_DB

Configured nodes: target

CSS critical: no

CPU count: 0

Memory target: 0

Maximum memory: 0

Default network number for database services:

Database is administrator managed

-- Use the crsctl query crs release version command to display the version of the Oracle Clusterware software

```
[grid@target ~]$ crsctl query crs software version -all
```

```
Oracle Clusterware version on node [target] is [19.0.0.0.0]
```

```
--Check the current service name on the target.
```

```
SQL> select value from v$parameter where name='service_names';
```

```
VALUE
```

```
-----  
TARGET_DB.xyz.xyz.xyz.com
```

```
-- Ensure that the wallet STATUS is OPEN and WALLET_TYPE is  
AUTOLOGIN
```

```
For Oracle Database 12c Release 2 and later, if the Source and Target Databases do  
not have Transparent Data Encryption (TDE) enabled, then it is mandatory that you  
configure the TDE keystore before migration begins.
```

```
SQL> select WRL_TYPE,WRL_PARAMETER,STATUS,CON_ID FROM v$encryption_wallet;
```

```
WRL_TYPE      WRL_PARAMETER                                STATUS  CON_ID  
-----  
FILE          /opt/oracle/dcs/commonstore/wallets/tde/TARGET_DB/ OPEN    1  
FILE                                                OPEN    2  
FILE                                                OPEN    3
```

```
SQL> show pdbs
```

```
CON_ID  CON_NAME                                OPEN MODE  RESTRICTED  
-----  
2  PDB$SEED                                READ ONLY  NO  
3  PDB1                                    READ WRITE NO
```

```
SQL> alter session set container=pdb1;
```

```
Session altered.
```

```
SQL> select owner,tablespace_name from dba_tables where owner = 'TEST';
```

```
OWNER      TABLESPACE_NAME  
-----  
TEST      TEST
```

```
SQL> select d.TABLESPACE_NAME, d.FILE_NAME from dba_data_files d, v$datafile v where  
d.FILE_ID = v.FILE# order by d.TABLESPACE_NAME, d.FILE_NAME;
```

```
TABLESPACE  FILE_NAME  
-----  
-----
```

```
SYSAUX
```

```
+DATA/TARGET_DB/C1B89AAB24203930E0533100000A0129/DATAFILE/sysaux.271.1071902309
```

```
SYSTEM
```

```
+DATA/TARGET_DB/C1B89AAB24203930E0533100000A0129/DATAFILE/system.276.1071902299
```

```
TEST
```

```
+DATA/TARGET_DB/C1B89AAB24203930E0533100000A0129/DATAFILE/test.282.1072487049
```

```
UNDOTBS1
+DATA/TARGET_DB/C1B89AAB24203930E0533100000A0129/DATAFILE/undotbs1.272.1071902319
USERS
+DATA/TARGET_DB/C1B89AAB24203930E0533100000A0129/DATAFILE/users.275.1071902287
```

-- Create a GoldenGate administration user, ggadmin (in the PDB in case of Multitenant):

```
SQL> alter session set container=pdb1;
SQL> create user ggadmin identified by WElcome##1234 default tablespace users
temporary tablespace temp;
SQL> grant connect, resource to ggadmin;
SQL> grant unlimited tablespace to ggadmin;
SQL> alter user ggadmin quota 100M on users;
SQL> grant select any dictionary to ggadmin;
SQL> grant create view to ggadmin;
SQL> grant execute on dbms_lock to ggadmin;
SQL> exec dbms_goldengate_auth.GRANT_ADMIN_PRIVILEGE('ggadmin');
```

-- You need to connect to a CDB, Enable initialization parameter ENABLE_GOLDENGATE_REPLICATION:

```
SQL> show parameter ENABLE_GOLDENGATE_REPLICATION
NAME                                TYPE                                VALUE
-----                                -
enable_goldengate_replication        boolean                             FALSE
```

```
SQL> alter system set ENABLE_GOLDENGATE_REPLICATION=TRUE scope=both;
System altered.
```

```
SQL> show parameter ENABLE_GOLDENGATE_REPLICATION
NAME                                TYPE                                VALUE
-----                                -
enable_goldengate_replication        boolean                             TRUE
```

-- DATA PUMP Required Target preparation

```
SQL> alter user SYSTEM identified by Welcome##1234;
User Altered.
```

-- Grant DATAPUMP_IMP_FULL_DATABASE role to SYSTEM

```
SQL> grant DATAPUMP_IMP_FULL_DATABASE to system;
Grant succeeded.
```

Target Database Port Requirements

- **Purpose:** SSH
 - **Port:** 22
 - **Protocol:** TCP
- **Purpose:** SQL*NET
 - **Port:** 1521, 2484 or a DB Scan listener
 - **Protocol:** TCP
- **Purpose:** Database Backup Store. OCI OSS
 - **Port:** 443
 - **Protocol:** HTTP

You can find more information on the Oracle Zero Downtime Migration documentation section “*Configuring Required Connections.*”

- <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Connectivity

SSH Key Pair

ZDM connects via SSH to the Source Database servers; hence an SSH key pair for the zdmuser is required. As zdmuser, run the following:

```
[zdmuser@zdmhost ~]$ mkdir ~/.ssh
[zdmuser@zdmhost ~]$ chmod 700 ~/.ssh
[zdmuser@zdmhost ~]$ /usr/bin/ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/zdmuser/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/zdmuser/.ssh/id_rsa.
Your public key has been saved in /home/zdmuser/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:keyfingerprintsample zdmuser@zdmhost
[zdmuser@zdmhost ~]$ cd ~/.ssh
[zdmuser@zdmhost .ssh]$ cat id_rsa.pub >> authorized_keys
[zdmuser@zdmhost .ssh]$ chmod 600 authorized_keys
```

You can find more information on ZDM Product’s documentation section, “**Generating a Private SSH Key Without a Passphrase.**”

- <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Before continuing with the migration environment setup, rename the id_rsa.pub file to <zdm_service_host_name>.ppk on the ZDM Service Host.

```
[zdmuser@zdmhost .ssh]$ cd /home/zdmuser/.ssh
[zdmuser@zdmhost .ssh]$ mv id_rsa zdm.ppk
```


Upon the creation of the GoldenGate Hub deployment, connect to the VM via SSH using its Public IP address to get the oggadmin user password:

```
-bash-4.2$ cat /home/opc/ogg-credentials.json
{"username": "oggadmin", "credential": "xyzxyzxyzxyzxyz"}
```

Proceed to add the server's hostname and IP information into the ZDM host /etc/hosts file.

```
-bash-4.2$ cat /etc/hosts
10.0.0.158 ogg21cora.x.y.z.com ogg21cora
```

Connectivity between ZDM Service Host, Source, Target, and GoldenGate Hub

Configure the /etc/hosts file as a first step to ensure connectivity between the ZDM Service Host and the Source and Target Database servers. As the root user on the ZDM Service Host, adding the Source Database server, Target Database server, and OGG Hub information:

```
[root@zdmhost zdminstall]# vi /etc/hosts
[root@zdmhost]# vi /etc/hosts
Source_ip    source.publicsubnet.xyz.xyz.com    source    ##Source Database
Target_ip    target.publicsubnet.xyz.xyz.com    target    ##Target Database
GGHub_ip     ogg_fqdn ogg_hostname ##OGG Hub
```

For more information regarding connectivity, please visit Oracle Zero Downtime Migration's product documentation at: <https://docs.oracle.com/en/database/oracle/zero-downtime-migration>

Backup Location

Object Storage Requirements

When migrating to OCI Native Databases, ZDM requires a backup location to export Data Pump dump files. The Target Database service can leverage them for instantiating the Target Database; this backup location will be an Object Storage bucket within the customer's tenancy. To create an Object Storage bucket in your OCI Dashboard, select the hamburger menu in the top left, click on **Storage**, and then on **Buckets**. Click on **Create Bucket**.

The following details are required:

- **Bucket Name:** For this step-by-step guide, the name used will be ZDMBucket; please enter this or the name of your choice.
- **Default Storage Tier:** For this step-by-step guide, **Standard** will be used; please select this or the tier appropriate to your use case.
- **Encryption:** For this step-by-step guide, **Encrypt using Oracle-managed keys** will be used; please select this or the tier appropriate to your use case.

There are also options for **Tags**; this step-by-step guide does not use them, but please evaluate and select according to your use case and needs.

Next, on the Details page, the two most important pieces of information you need to save are the bucket name and the namespace; keep them; they will be required for the migration later.

Preparing the Response File

Oracle Zero Downtime Migration leverages a response file that is fully customizable by the customer. A wide array of parameters for the logical migration methodology allows the customer to configure the migration according to the appropriate use case. This step-by-step guide uses a specific set of response file parameters; a detailed description is present only for the parameters used here. For more information on the complete response file parameters for logical migration, refer to ZDM's Product Documentation section **Zero Downtime Migration Logical Migration Response File Parameters Reference**.

- <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Response File Parameters used in this guide

- **Parameter:** MIGRATION_TYPE
 - **Description:** ZDM will leverage Data Pump and Oracle GoldenGate for the migration process. (LOGICAL_ONLINE)
- **Parameter:** DATA_TRANSFER_MEDIUM
 - **Description:** Object Storage Service. (OSS)
- **Parameter:** TARGETDATABASE_OCID
 - **Description:** Specifies the connection details for the Oracle Cloud resource identifier for the Target Database.
- **Parameter:** TARGETDATABASE_ADMINUSERNAME
 - **Description:** Specifies the Target Database administrator's username.
- **Parameter:** SOURCEDATABASE_ADMINUSERNAME
 - **Description:** Specifies the Source Database administrator's username.
- **Parameter:** SOURCEDATABASE_CONNECTIONDETAILS_HOST
 - **Description:** Specifies the listener hostname or IP address.
- **Parameter:** SOURCEDATABASE_CONNECTIONDETAILS_PORT
 - **Description:** Specifies the listener port number.
- **Parameter:** TARGETDATABASE_CONNECTIONDETAILS_SERVICENAME
 - **Description:** Specifies the fully qualified service name
- **Parameter:** TARGETDATABASE_CONNECTIONDETAILS_HOST
 - **Description:** Specifies the listener hostname or IP address
- **Parameter:** TARGETDATABASE_CONNECTIONDETAILS_PORT
 - **Description:** Specifies the listener port number.
- **Parameter:** OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_TENANTID
 - **Description:** Specifies the OCID of the OCI tenancy.
- **Parameter:** OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_USERID
 - **Description:** Specifies the OCID of the IAM user.
- **Parameter:** OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_FINGERPRINT
 - **Description:** Specifies the fingerprint of the public API key.
- **Parameter:** OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_PRIVATEKEYFILE
 - **Description:** Specifies the absolute path of the API private key file.

- **Parameter:** OCIAUTHENTICATIONDETAILS_REGIONID
 - **Description:** Specifies the OCI region identifier.
- **Parameter:** SOURCEDATABASE_GGADMINUSERNAME
 - **Description:** Specifies the GoldenGate administrator's username.
- **Parameter:** TARGETDATABASE_GGADMINUSERNAME
 - **Description:** Specifies the GoldenGate administrator's username for the Target Database.
- **Parameter:** GOLDENGATEHUB_ADMINUSERNAME
 - **Description:** Specifies the GoldenGate Hub administrator's username.
- **Parameter:** GOLDENGATEHUB_URL
 - **Description:** Specifies the GoldenGate Hub's REST endpoint.
- **Parameter:** GOLDENGATEHUB_SOURCEDEPLOYMENTNAME
 - **Description:** Specifies the name of the GoldenGate Microservices deployment to operate on the Source Database. Since OGG 21c, there is only one deployment, and hence the name of the deployment will be the same in this parameter, and the next one (target deployment name)
- **Parameter:** GOLDENGATEHUB_TARGETDEPLOYMENTNAME
 - **Description:** Specifies the name of the GoldenGate Microservices deployment to operate on the Target Database. Since OGG 21c, there is only one deployment, and hence the name of the deployment will be the same in this parameter and the previous one (source deployment name)
- **Parameter:** GOLDENGATEHUB_COMPUTEID
 - **Description:** Specifies the Oracle Cloud identifier of the VM.
- **Parameter:** GOLDENGATEHUB_ALLOWSELSIGNEDCERTIFICATE
 - **Description:** specify this parameter to TRUE in the response file, this tells ZDM to trust the self-signed HTTPS certificate.
- **Parameter:** DATAPUMPSETTINGS_JOBMODE
 - **Description:** Specifies the Data Pump export mode: FULL, SCHEMA, TABLE.
- **Parameter:** DATAPUMPSETTINGS_DATAPUMPPARAMETERS_IMPORTPARALLELISMDEGREE
 - **Description:** Specifies the maximum number of worker processes a Data Pump import job can use.
- **Parameter:** DATAPUMPSETTINGS_DATAPUMPPARAMETERS_EXPORTPARALLELISMDEGREE
 - **Description:** Specifies the maximum number of worker processes a Data Pump export job can use.
- **Parameter:** DATAPUMPSETTINGS_DATABUCKET_NAMESPACENAME
 - **Description:** Specifies the object storage bucket namespace.
- **Parameter:** DATAPUMPSETTINGS_DATABUCKET_BUCKETNAME
 - **Description:** Specifies the object storage bucket name.
- **Parameter:** DATAPUMPSETTINGS_EXPORTDIRECTORYOBJECT_NAME
 - **Description:** Specifies a directory name on the source server to store the Data Pump Export dump files. ZDM will create this object if it does not exist already.
- **Parameter:** DATAPUMPSETTINGS_EXPORTDIRECTORYOBJECT_PATH
 - **Description:** Specifies a directory path on the source server to store the Data Pump Export dump files. ZDM will create this object if it does not exist already.

- **Parameter:** DATAPUMPSETTINGS_IMPORTDIRECTORYOBJECT_NAME
 - **Description:** Specifies a directory path on the target server to store the Data Pump Export dump files. ZDM will create this object if it does not exist already.
- **Parameter:** DATAPUMPSETTINGS_CREATEAUTHTOKEN
 - **Description:** Specifies if an OCI Authentication Token is needed to be created for the specified OCI user to import the Data Dump Files from the Object Storage into an Autonomous Database. For DBCS/ExaCS migration, this parameter is FALSE.

To run the migration described in this step-by-step guide, the sample response file will be as follows.

As the **zdmuser**, run the following commands:

```
[zdmuser@zdmhost ]$ cd ~
[zdmuser@zdmhost ]$ mkdir template
[zdmuser@zdmhost ]$ cp /u01/app/zdmhome/rhp/zdm/template/zdm_logical_template.rsp
~/template
[zdmuser@zdmhost ]$ cd template
[zdmuser@zdmhost ]$ cp zdm_logical_template.rsp zdm_logical_online.rsp
[zdmuser@zdmhost ]$ vi zdm_logical_online.rsp
:%d
```

The **:%d** command in vi deletes all of the existing lines. After deleting the content of the file, paste the below contents into the empty file:

```
# migration method
MIGRATION_METHOD=ONLINE_LOGICAL
DATA_TRANSFER_MEDIUM=OSS

# target db 19c OCID and ADMIN USER
TARGETDATABASE_OCID=ocid1.database.oc1.xyz.xyz <UPDATE>
TARGETDATABASE_ADMINUSERNAME=SYSTEM

# source db
SOURCEDATABASE_ADMINUSERNAME=SYSTEM
SOURCEDATABASE_CONNECTIONDETAILS_HOST=source
SOURCEDATABASE_CONNECTIONDETAILS_PORT=1521
SOURCEDATABASE_CONNECTIONDETAILS_SERVICENAME=SOURCE_DB.xyz.xyz.oraclevcn.com <UPDATE>

# target db (PDB)
TARGETDATABASE_CONNECTIONDETAILS_HOST=target
TARGETDATABASE_CONNECTIONDETAILS_PORT=1521
TARGETDATABASE_CONNECTIONDETAILS_SERVICENAME=pdb1.publicsubnet.xyz.xyz.com <UPDATE>

# oci cli
OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_TENANTID=ocid1.tenancy.oc1.xyz.xyz <UPDATE>
OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_USERID=ocid1.user.oc1..xyz <UPDATE>
```

```

OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_FINGERPRINT=xyzxyzxyzxyzxyzxyz <UPDATE>
OCIAUTHENTICATIONDETAILS_USERPRINCIPAL_PRIVATEKEYFILE=/home/zdmuser/.oci/oci_api_key.pem
<UPDATE>
OCIAUTHENTICATIONDETAILS_REGIONID=UPDATE-WITH-YOUR-REGION <UPDATE>

## GoldenGate
SOURCEDATABASE_GGADMINUSERNAME=ggadmin
TARGETDATABASE_GGADMINUSERNAME=ggadmin
GOLDENGATEHUB_ADMINUSERNAME=oggadmin
GOLDENGATEHUB_URL=https://ogg21cora.publicsubnet.xyz.xyz.com <UPDATE>
GOLDENGATEHUB_SOURCEDEPLOYMENTNAME=OGGDEPLOYMENT NAME <UPDATE>
GOLDENGATEHUB_TARGETDEPLOYMENTNAME=OGGDEPLOYMENT NAME <UPDATE>
GOLDENGATEHUB_COMPUTEID=ocidl.instance.oc1.xyz.yyx.xyz <UPDATE>

# data pump
DATAPUMPSETTINGS_JOBMODE=SCHEMA
INCLUDEOBJECTS-1=owner:TEST
DATAPUMPSETTINGS_DATAPUMPPARAMETERS_IMPORTPARALLELISMDEGREE=2
DATAPUMPSETTINGS_DATAPUMPPARAMETERS_EXPORTPARALLELISMDEGREE=2
DATAPUMPSETTINGS_DATABUCKET_NAMESPACENAME=namespace <UPDATE>
DATAPUMPSETTINGS_DATABUCKET_BUCKETNAME=name <UPDATE>
DATAPUMPSETTINGS_EXPORTDIRECTORYOBJECT_NAME=DATA_PUMP_DIR
DATAPUMPSETTINGS_EXPORTDIRECTORYOBJECT_PATH=/u01/app/oracle/product/11.2.0.4/dbhome_1/rdbms/log/
DATAPUMPSETTINGS_IMPORTDIRECTORYOBJECT_NAME=DATA_PUMP_DIR
DATAPUMPSETTINGS_CREATEAUTHTOKEN=FALSE

```

As you can see, there are several parameters whose value is <UPDATE>, this is for illustration purposes of this step-by-step guide; please update with the values of your environment as described above.

Logical Online Migration to DBCS and ExaCS with ZDM

Performing a Test Database Migration in Evaluation Mode

Oracle Zero Downtime Migration includes an evaluation mode that performs a dry run of the migration process; this is an optional step. It allows customers to ensure that the migration runs swiftly and encounters no issues. When migrating with the evaluation flag on, ZDM evaluates all the different stages and will alert the user if there are any inconsistencies or potential issues; this way, customers can fix any problems beforehand. As a best practice, run a Test Database Migration before executing the migration. To do this, please perform as follows:

```

[zdmuser@zdmhost logs]$ $ZDM_HOME/bin/zdmcli migrate database -sourcedb SOURCE_DB \
-sourcenode source \
-srcauth zdmauth \
-srcarg1 user:opc \
-srcarg2 identity_file:/home/zdmuser/.ssh/zdm.ppk \
-srcarg3 sudo_location:/usr/bin/sudo \
-targetnode target -rsp /home/zdmuser/logical_online.rsp \
-tgtauth zdmauth \
-tgtarg1 user:opc \

```

```
-tgtarg2 identity_file:/home/zdmuser/.ssh/zdm.ppk \  
-tgtarg3 sudo_location:/usr/bin/sudo \  
-eval
```

Bear in mind that `-sourcedb` is used for databases where the source is part of an Oracle Grid Infrastructure deployment; for Source Databases that are single instance with no Oracle Grid Infrastructure (using Logical Volume Manager instead), please use `-sourcesid` with the source `ORACLE_SID`.

ZDM will then request the different required passwords and generate a job id.

```
zdmhost.publicsubnet.xyz.xyz.com: Audit ID: 264  
Enter Source Database administrative user "SYSTEM" password: WELCOME##1234  
Enter Source Database administrative user "ggadmin" password: WELCOME##1234  
Enter Target Database administrative user "ADMIN" password: WELCOME##1234  
Enter Target Database administrative user "ggadmin" password: WELCOME##1234  
Enter Oracle GoldenGate hub administrative user "oggadmin" password: your password  
Enter Authentication Token for OCI user "ocidl.user.ocl..xyz": your token  
Enter Data Pump encryption password: WELCOME##1234  
Operation "zdmcli migrate database" scheduled with the job ID "90".
```

The generated job id can be queried for progress using the `zdmcli query job -jobid job_id` command.

```
[zdmuser@zdmhost logs]$ $ZDM_HOME/bin/zdmcli query job -jobid 90  
zdmhost.publicsubnet.xyz.xyz.com: Audit ID: 280  
Job ID: 90  
User: zdmuser  
Client: zdmhost  
Job Type: "EVAL"  
Scheduled job command: "zdmcli migrate database -sourcedb SOURCE_DB -sourcenode source -srcauth  
zdmauth -srcarg1 user:opc -srcarg2 identity_file:/home/zdmuser/.ssh/zdm.ppk -srcarg3  
sudo_location:/usr/bin/sudo -targetnode target -rsp /home/zdmuser/logical_online.rsp -tgtauth  
zdmauth -tgtarg1 user:opc -tgtarg2 identity_file:/home/zdmuser/.ssh/zdm.ppk -tgtarg3  
sudo_location:/usr/bin/sudo -eval"  
Current status: SUCCEEDED  
ZDM_VALIDATE_TGT ..... COMPLETED  
ZDM_VALIDATE_SRC ..... COMPLETED  
ZDM_SETUP_SRC ..... COMPLETED  
ZDM_PRE_MIGRATION_ADVISOR ..... COMPLETED  
ZDM_VALIDATE_GG_HUB ..... COMPLETED  
ZDM_VALIDATE_DATAPUMP_SETTINGS_SRC .... COMPLETED  
ZDM_VALIDATE_DATAPUMP_SETTINGS_TGT .... COMPLETED  
ZDM_CLEANUP_SRC ..... COMPLETED
```

Performing a Database Migration

To perform the database migration once the migration command with the evaluation flag is completed successfully and without errors and warnings, run the same command without the `-eval` option:

```
[zdmuser@zdmhost logs]$ $ZDM_HOME/bin/zdmcli migrate database -sourcedb SOURCE_DB \  
-sourcenode source \  
-srcauth zdmauth \  
-srcarg1 user:opc \  
-srcarg2 identity_file:/home/zdmuser/.ssh/zdm.ppk \  
-srcarg3 sudo_location:/usr/bin/sudo \  
-rsp /home/zdmuser/logical_online.rsp \  
zdmhost.publicsubnet.xyz.xyz.com: Audit ID: 271  
Enter Source Database administrative user "SYSTEM" password: WELCOME##1234  
Enter Source Database administrative user "ggadmin" password: WELCOME##123  
Enter Target Database administrative user "ADMIN" password: WELCOME##1234  
Enter Target Database administrative user "ggadmin" password: WELCOME##1234  
Enter Oracle GoldenGate hub administrative user "oggadmin" password: your password
```

Enter Authentication Token for OCI user "ocidl.user.oc1..xyz": your token
Enter Data Pump encryption password: WELCOME##1234
Operation "zdmcli migrate database" scheduled with the job ID "91".

Proceed to periodically query the migration job with the provided migration job id until completed:

```
[zdmuser@zdmhost ~]$ $ZDM_HOME/bin/zdmcli query job -jobid 91
zdmhost.publicsubnet.xyz.xyz.com: Audit ID: 307
Job ID: 34
User: zdmuser
Client: zdmhost
Job Type: "MIGRATE"
Scheduled job command: "zdmcli migrate database -sourcedb SOURCE_DB -sourcename source -
srcauth zdmauth -srcarg1 user:opc -srcarg2 identity_file:/home/zdmuser/.ssh/zdm.ppk -
srcarg3 sudo_location:/usr/bin/sudo -rsp /home/zdmuser/logical_online.rsp"
Current status: SUCCEEDED
ZDM_VALIDATE_TGT ..... COMPLETED
ZDM_VALIDATE_SR ..... COMPLETED
ZDM_SETUP_SRC ..... COMPLETED
ZDM_PRE_MIGRATION_ADVISOR ..... COMPLETED
ZDM_VALIDATE_GG_HUB ..... COMPLETED
ZDM_VALIDATE_DATAPUMP_SETTINGS_SRC .... COMPLETED
ZDM_VALIDATE_DATAPUMP_SETTINGS_TGT .... COMPLETED
ZDM_PREPARE_GG_HUB ..... COMPLETED
ZDM_ADD_HEARTBEAT_SRC ..... COMPLETED
ZDM_ADD_SCHEMA_TRANSDATA_SRC ..... COMPLETED
ZDM_CREATE_GG_EXTRACT_SRC ..... COMPLETED
ZDM_PREPARE_DATAPUMP_SRC ..... COMPLETED
ZDM_PREPARE_DATAPUMP_TGT ..... COMPLETED
ZDM_DATAPUMP_EXPORT_SRC ..... COMPLETED
ZDM_UPLOAD_DUMPS_SRC ..... COMPLETED
ZDM_DATAPUMP_IMPORT_TGT ..... COMPLETED
ZDM_POST_DATAPUMP_SRC ..... COMPLETED
ZDM_POST_DATAPUMP_TGT ..... COMPLETED
ZDM_ADD_HEARTBEAT_TGT ..... COMPLETED
ZDM_ADD_CHECKPOINT_TGT ..... COMPLETED
ZDM_CREATE_GG_REPLICAT_TGT ..... COMPLETED
ZDM_MONITOR_GG_LAG ..... COMPLETED
ZDM_SWITCHOVER_APP ..... COMPLETED
ZDM_RM_GG_EXTRACT_SRC ..... COMPLETED
ZDM_RM_GG_REPLICAT_TGT ..... COMPLETED
ZDM_DELETE_SCHEMA_TRANSDATA_SRC ..... COMPLETED
ZDM_RM_HEARTBEAT_SRC ..... COMPLETED
ZDM_RM_CHECKPOINT_TGT ..... COMPLETED
ZDM_RM_HEARTBEAT_TGT ..... COMPLETED
ZDM_CLEAN_GG_HUB ..... COMPLETED
ZDM_POST_ACTIONS ..... COMPLETED
ZDM_CLEANUP_SRC ..... COMPLETED
```

Troubleshooting & Other Resources

For Oracle ZDM log review:

- ZDM Server host logs:
 - Check - \$ZDM_BASE/crsdata/zdmserver.log.0
- ZDM source node Data Pump logs:
 - DATAPUMPSETTINGS_EXPORTDIRECTORYOBJECT_PATH
- ZDM target node logs:
 - DATAPUMPSETTINGS_IMPORTDIRECTORYOBJECT_NAME
- Import Log
 - OSS Bucket
- OGG hub logs:
 - /u02/deployments/<ogg_deployment_name>/var/log

For all Oracle Support Service Requests related to Zero Downtime Migration, please be sure to follow the instructions in My Oracle Support Document:

- SRDC – Data Collection for Database Migration Using Zero Downtime Migration (ZDM) (DOC ID 2595205.1)
- <https://support.oracle.com/epmos/faces/DocContentDisplay?id=2595205.1>

All common issues are documented and updated periodically in Oracle Zero Downtime Migration's product documentation, specifically in the Product Release Notes, Known Issues section:

- <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Please review our Maximum Availability Architecture document for best practices related to Zero Downtime Migration.

- MAA Practices for Cloud Migration Using ZDM (Doc ID 2562063.1)
- <https://support.oracle.com/epmos/faces/DocContentDisplay?id=2562063.1>

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