

Oracle Zero Downtime Migration (ZDM) & Oracle Advanced Cluster File System

Step-by-Step Guide – Logical Migration from On-Premises to Exadata Cloud@Customer or
Exadata On-Premises using ACFS as a Backup Location

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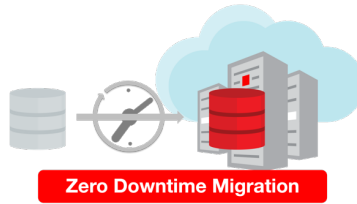


Figure 1. The Oracle Zero Downtime Migration Logo comprises a Database and a Clock with an arrow pointing to a Database deployed in the Cloud.

Purpose

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. 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), Oracle Cloud Infrastructure, Oracle Database@Azure, and Oracle Database@Google Cloud. 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.

Fulfilling all industry standards, complying with POSIX and X/OPEN, Oracle Advanced Cluster File System, ACFS, and supporting multiple operating systems such as Oracle Linux, Redhat, Novell SLES, Solaris, and AIX. Oracle ACFS supports various server platforms, from traditional server environments to Oracle Engineered Systems such as the Oracle Exadata Database Machine and Cloud at Customer Deployments like Exadata Cloud@Customer. It is steadily becoming the storage foundation of choice for diverse Cloud offerings.

This technical brief is a step-by-step guide for leveraging your existing Oracle ACFS cluster file systems on your Exadata On-Premises or Exadata Cloud@Customer deployments as part of ZDM's migration workflow. The scenario for this migration uses Oracle ACFS NAS-MAX Extensions to export HA-NFS on top of ACFS. ZDM will then use this exported file system as a backup location, eliminating the need to provide external NFS storage in your data center, thus making your migration process more cost-effective.

With Zero Downtime Migration's Logical workflow, this step-by-step guide will help migrate your on-premises Oracle Databases to the Exadata Cloud@Customer or Exadata On-Premises.

Oracle ZDM will run on a separate node and connect to Source and Target to perform the migration. This guide will cover all requirements for installing the Oracle ZDM service host, the Source Database to be migrated, the Target Database recipient of the migration process, the backup leveraging Oracle ACFS, and the 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.¹

¹ <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, deployed on Oracle Public Cloud Gen 1 or Oracle Cloud Infrastructure. The Target Database deployment can be Base Database Service, Exadata Database Service on Dedicated Infrastructure, Exadata Cloud at Customer, Autonomous Database, Oracle Database@Azure, Oracle Database@Google Cloud, and Oracle Database@AWS. 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 HA-NFS on top of Oracle ACFS 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. ZDM handles each step for offline and online workflows and automates everything.

Supported Configurations

Oracle ZDM supports Oracle Database versions 11.2.0.4, 12.1.0.2, 12.2.0.1, 18c, 19c, 21c and 23ai.

Oracle ZDM supports Oracle Databases hosted on Linux operating systems. It also supports single-instance, RAC One Node, or RAC databases as sources and Oracle Database Enterprise and 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 21c, Oracle ZDM allows non-CDB databases to be migrated to Pluggable Databases on the fly, allowing for complete conversion and adding more versatility to the migration workflow.

Logical Migration

Logical Offline Migration with a Backup Location

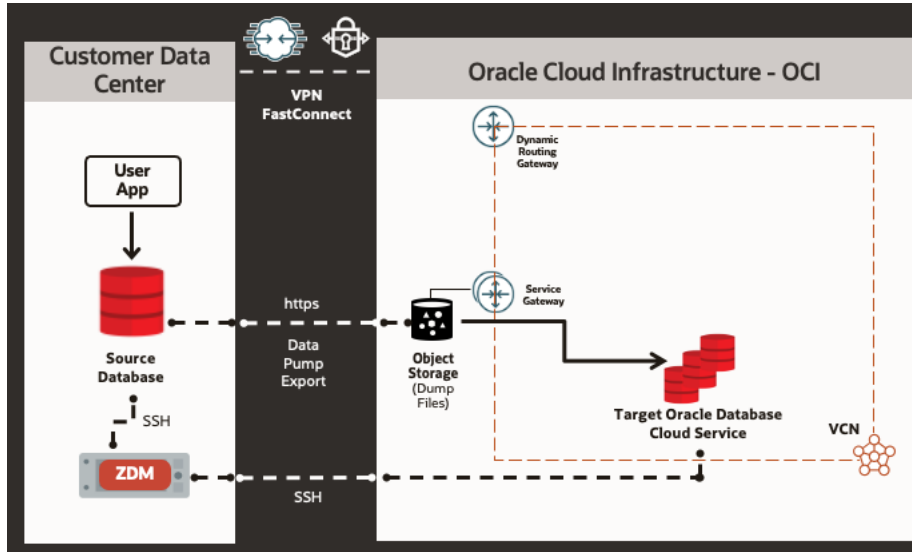


Figure 2. ZDM Logical Offline Migration Architectural Diagram

A standard logical offline migration with a backup location will take the following steps:

1. Download and Configure ZDM.
2. ZDM Starts Database Migration.
3. ZDM Connects the Source Database to the 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 and Finalizes the Migration Process.

This workflow is supported by Oracle Base Database Service, Exadata Database Service on Dedicated Infrastructure, Exadata Database Service on Cloud@Customer, Exadata On-Premises, Autonomous Database, Oracle Database@Azure and Oracle Database@Google Cloud.

Logical Online Migration with a Backup Location

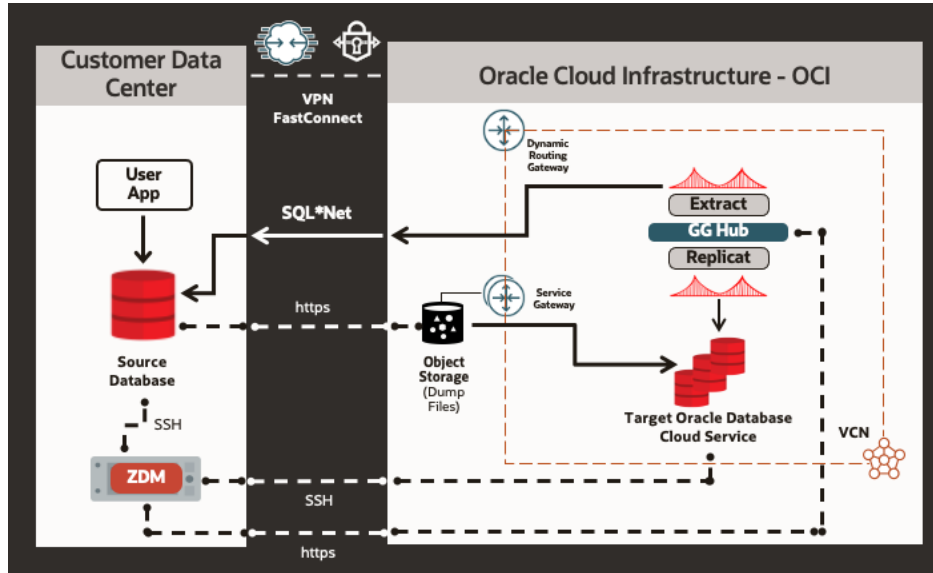


Figure 3. ZDM Logical Online Migration Architectural Diagram

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.

This workflow is supported by Oracle Base Database Service, Exadata Database Service on Dedicated Infrastructure, Exadata Database Service on Cloud@Customer, Exadata On-Premises, Autonomous Database, Oracle Database@Azure and Oracle Database@Google Cloud.

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 7,8, RHEL8,9 (must be within this OS versions).
- 100 GB of free storage space
- A `zdm` group and a `zdmuser` as part of this group; please create them as follows:
 - `[root@zdm-servicenode ~]# groupadd zdm -g 1001`
 - `[root@zdm-servicenode ~]# useradd zdmuser -g 1001`
- The following packages must be installed:
 - `glibc-devel`
 - `expect`
 - `unzip`
 - `libaio`
 - `oraclelinux-developer-release-el7`
- No Oracle Grid Infrastructure is running on it.
- All hostnames and IP addresses must be present as entries at `/etc/hosts`.

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*² section.

ZDM Service Host Installation

ZDM can be installed on a Server or Virtual Machine and deployed anywhere. Beyond 100GB of free storage, the ZDM Service Host does not have other specific hardware requirements.

To download ZDM binaries, please visit www.oracle.com/database/technologies/rac/zdm-downloads.html

Accept the Oracle License Agreement and download the ZDM binaries on the ZDM Service host.

Once logged in to the ZDM host:

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
```

² <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

```
[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 run ZDM'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 bullet list 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:** 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 in 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. Before starting the migration, follow these recommendations.

- 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

Target Database

Target Database Requirements

Zero Downtime Migration will migrate the Source Database to a database on Exadata Cloud@Customer or Exadata On-Premises. Before migrating, you must create a placeholder database on the Target Deployment. 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 the same or higher than the Source Database. Migration to a lower version of the database is not supported.
- **Character set:** the character set on the Source and Target Database must be the same.
- **Database time zone:** The 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/adb

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

If the Target database is not an Autonomous database, create all relevant GGADMIN users by following:

- “Additional Logical Migration Prerequisites”
 - <https://docs.oracle.com/en/database/oracle/zero-downtime-migration/index.html>

Target Database Port Requirements

- **Purpose:** SSH
 - **Port:** 22
 - **Protocol:** TCP
- **Purpose:** SQL*NET
 - **Port:** 1521, 2484 or a DB Scan listener
 - **Protocol:** TCP

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
```

More information is available in ZDM Product’s documentation section, **“Generating a Private SSH Key Without a Passphrase.”**

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

Before continuing with the migration environment setup, please add the authorized key locations in the id_rsa.pub file to all target database servers.

Connectivity between the ZDM Service Host and the Source and Target Database Servers

Configure /etc/hosts 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 opc]# vi /etc/hosts
10.0.0.XX source.xyz.xyz.com source ##Source Database
10.0.0.YY target.xyz.xyz.com target ##Target Database
10.0.0.XYZ ogg21cora.xyz.xyz.com ogg21cora ##OGG Hub
10.0.0.ABC zdmhost.xyz.xyz.com zdmhost ##ZDM Host
```

Adding ZDM Host Public Keys to the Source Database Server

Add the ZDM Host Public Keys to the Source Database Server Authorized Key files by executing the following on the Source Database server:

```
[source ~]$ cd /home/opc/.ssh
[source .ssh]$ echo "ssh-rsa SSHKEYSSHKEY zdmuser@zdmhost" >> authorized_keys
```

Adding ZDM Host Public Keys to the Target Database Server

Add the ZDM Host Public Keys to the Target Database Server Authorized Key files by executing the following on the Target Database server:

```
[target ~]$ cd /home/user/.ssh
[target .ssh]$ echo "ssh-rsa SSHKEYSSHKEY zdmuser@zdmhost" >> authorized_keys
```

Testing Connectivity from the ZDM Service Host to Source and Target Database Server

To test the connectivity from the ZDM Service Host to the Source and Target Database Server, execute the following as the zdmuser on the ZDM Service Host:

```
[zdmuser@zdmhost .ssh]$ ssh -i zdm.ppk user@source
[zdmuser@zdmhost .ssh]$ ssh -i zdm.ppk user@target
```

Backup Location

HA-NFS on top of Oracle ACFS with NAS | MAX Extensions

When performing a database migration, ZDM requires a backup location to export Data Pump dump files. ZDM will then leverage the Data Pump dump files to instantiate the Target Database. The backup location in this guide will be HA-NFS of an ExportFS associated with an Oracle ACFS filesystem. This HA-NFS will be in the target Exadata Cloud@Customer or Exadata On-Premises Deployment. Oracle Clusterware must be running on your Target deployment to create the HA-NFS that will be used as a backup location.

Setting up the HA-NFS can be resumed in 4 steps:

1. Create an ADVM volume
2. Create an ACFS filesystem
3. Add HAVIP and ExportFS
4. Mounting the ExportFS on the source database server

Proceed to follow these instructions on your target deployment:

Create an ADVM volume

Access SQL Plus as an ASM administrator

```
$ sqlplus -L / as sysasm
```

Add the new volume and look for its volume device; this information is essential. The volume used for this purpose is 100GB; however, adjust it according to your database size and approximate size.

```
SQL> ALTER DISKGROUP <DISKGROUP_NAME> ADD VOLUME <VOLUME_NAME> SIZE 100G;
SQL> SELECT volume_name, volume_device FROM V$ASM_VOLUME
       WHERE volume_name = '<VOLUME_NAME>';
```

Create an ACFS Filesystem

Create an Oracle ACFS filesystem; start by formatting the recently created ADVM volume:

```
$ mkfs.acfs -v <VOLUME_DEVICE>
```

Using SRVCTL, add a new filesystem, mount it on your desired path, and specify its type as ACFS. After this, you should be able to start it.

```
$ srvctl add filesystem -d <VOLUME_DEVICE> -g <DISKGROUP_NAME> -v <VOLUME_NAME> -m
<MOUNT_PATH> -fstype ACFS
$ srvctl start filesystem -device <VOLUME_DEVICE>
```

Add HAVIP and ExportFS

Add a Highly Available Virtual IP resource:

```
$ srvctl add havip -id <HAVIP_ID> -address <HOST_NAME | IP_ADDRESS>
```

Add an ExportFS resource. *It is important to ensure* <MOUNTPOINT_PATH> is a location inside or equal to the ACFS MOUNT_PATH.

```
$ srvctl add exportfs -name <EXPORT_NAME> -path <MOUNTPOINT_PATH> -id <HAVIP_ID> -
clients <CLIENTS> -options '<EXPORTFS_OPTIONS>';
$ srvctl start exportfs -name <EXPORT_NAME>
```

An ExportFS is now available to be mounted on a host that belongs to authorized clients.

Mounting the ExportFS on the source database server

The last step is to mount the ExportFS on the source database server; ZDM will use this mount as the backup location.

To mount, run the following command:

```
$ mount <DEVICE> <DIRECTORY>
```

This command will mount the file system available from `DEVICE` on the specified `DIRECTORY`. It is important to note that since the example on this page involves more than one node, and the ExportFS to mount lives on a different node, it is required to specify the host. An example of this:

```
$ mount HOST:DIRECTORY DIRECTORY
```

In this example, the ExportFS on the target is now mounted on `HOST`, the source database server for this guide.

Ensuring Dump File Access and Read Permissions

Ensure the Data Pump dump files in the NFS mounted path are readable by the target database user. To do so, verify that the unique identifiers (UIDs) for the source database user match the UIDs for the target database user.

Please complete the following prerequisites on the source database:

- If the IDs match, Data Pump dump files are readable by default, and no action is required
- If the IDs do not match, ZDM automatically discovers the target database user's primary group and changes the group of the dump files to it.
 - To perform this action, the source database user in the database server must belong to a group with the same group ID as that of the target database user's primary group.
 - If no group is available, create an auxiliary group on the source database server whose GID matches the GID of the target database user.
 - Configure the source database user to be a part of the auxiliary group.
- If GID is unavailable and the above two conditions cannot be met, you can use a specific attribute from ZDM's response file, `DUMPTRANSFERDETAILS_PUBLICREAD`. Set this value to `TRUE`, making the Data Pump dump files on NFS readable to others. Bear in mind that any user with access to this specific network storage can then read the Data Pump dump files when the above value is set to `TRUE`.

GoldenGate Hub

Oracle ZDM Logical Online, migration to ExadataC@C and Exadata On-Premises, requires an Oracle GoldenGate Microservices hub. Please abide by the Licensing and Terms of use for this software. Oracle Exadata On-Premises migration requires a user-provided Oracle GoldenGate license.

To set up the GoldenGate Hub, please follow the instructions as per:

- [Oracle GoldenGate Microservices on Oracle Cloud Marketplace](#)

Deploy the Oracle GoldenGate Microservices using the specific image from the Oracle Cloud Marketplace located in:

- [Oracle GoldenGate – Database Migrations](#)

Please visit the link, choose “Oracle GoldenGate—Database Migrations” from the main menu, and continue with the default version.

Upon Creating the GoldenGate Hub, follow the instructions on [Migrating to Exadata Cloud@Customer Using Oracle Zero Downtime Migration](#). The instructions walk you through a series of steps to download a docket container with a GoldenGate hub deployment that can be installed on your premises.

Preparing the Response File

Oracle Zero Downtime Migration leverages a response file that is fully customizable by the customer. For the logical migration methodology, a wide array of parameters 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 presented below. For more information on the complete set of 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:** Network File System (NFS)
- **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:** SOURCEDATABASE_CONNECTIONDETAILS_SERVICENAME
 - **Description:** Specifies the fully qualified service name.
- **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:** SOURCECONTAINERDATABASE_ADMINUSERNAME
 - **Description:** In the case of a multitenant-based Source Database, specifies the Database Administrator username.
- **Parameter:** SOURCECONTAINERDATABASE_GGADMINUSERNAME
 - **Description:** In the case of a multitenant-based Source Database, specifies the GoldenGate administrator username.
- **Parameter:** SOURCECONTAINERDATABASE_CONNECTIONDETAILS_HOST

- **Description:** In the case of a multitenant-based Source Database, specify the source's connection details (IP or Hostname).
- **Parameter:** SOURCECONTAINERDATABASE_CONNECTIONDETAILS_SERVICENAME
 - **Description:** In the case of a multitenant-based Source Database, specifies the fully qualified service name for the CDB.
- **Parameter:** SOURCECONTAINERDATABASE_CONNECTIONDETAILS_PORT
 - **Description:** In the case of a multitenant-based Source Database, specifies the Source Database connection port.
- **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_ALLOWSELSIGNEDCERTIFICATE
 - **Description:** Specify this parameter as 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 as 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_METADATAREMAPS-LIST_ELEMENT_NUMBER
 - **Description:** Defines remapping to be applied to objects as they are processed. This parameter can be added to the response file multiple times, one per object. To do so, replace the list_element_number for the object number and then the value to be added
- **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. If this object does not already exist, ZDM will create it.
- **Parameter:** DATAPUMPSETTINGS_CREATEAUTHTOKEN
 - **Description:** Specifies whether an OCI Authentication Token needs 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.
- **Parameter:** DATAPUMPSETTINGS_OMITENCRYPTIONCLAUSE
 - **Description:** When enabled, this parameter sets TRANSFORM=OMIT_ENCRYPTION_CLAUSE, which directs the Data Pump to suppress any encryption clauses associated with objects using encrypted columns.
- **Parameter:** DATAPUMPSETTINGS_FIXINVALIDOBJECTS
 - **Description:** Indicates whether invalid objects are recompiled in the database as part of the Data Pump workflow during the migration.
- **Parameter:** DATAPUMPSETTINGS_SECUREFILELOB
 - **Description:** Sets TRANSFORM=LOB_STORAGE: SECUREFILE, which directs Data Pump to transform basic LOBs into secure file LOBs during the Data Pump Import.
- **Parameter:** DATAPUMPSETTINGS_SKIPDEFAULTTRANSFORM
 - **Description:** Skips default transform parameters.
- **Parameter:** DUMPTRANSFERDETAILS_PARALLELCOUNT
 - **Description:** Specifies the # of Export Dump files to transfer to the backup location in parallel.
- **Parameter:** DUMPTRANSFERDETAILS_RETRYCOUNT
 - **Description:** Specifies the number of times to retry the upload of Data Pump Dump files to the backup location.

The sample response file will be used to run the migration described in this step-by-step guide.

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

```
[zdmuser@zdmhost bin]$ cp
/home/zdmuser/zdmhome/rhp/zdm/template/zdm_logical_template.rsp /home/zdmuser
[zdmuser@zdmhost bin]$ cd /home/zdmuser
[zdmuser@zdmhost ~]$ mv zdm_logical_template.rsp logical_online.rsp
[zdmuser@zdmhost ~]$ chmod +w logical_online.rsp
[zdmuser@zdmhost ~]$ vi logical_online.rsp
```

Then proceed to edit the response file accordingly and with your environment values:

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

```
# source db
```

```
SOURCEDATABASE_ADMINUSERNAME=SYSTEM
SOURCEDATABASE_CONNECTIONDETAILS_HOST=source
SOURCEDATABASE_CONNECTIONDETAILS_PORT=1521
SOURCEDATABASE_CONNECTIONDETAILS_SERVICENAME=SOURCE_DB.xyz.xyz

# target db (PDB)
TARGETDATABASE_CONNECTIONDETAILS_HOST=target
TARGETDATABASE_CONNECTIONDETAILS_PORT=1521
TARGETDATABASE_CONNECTIONDETAILS_SERVICENAME=pdb1.xyz.xyz.xyz
TARGETDATABASE_ADMINUSERNAME=SYSTEM

## GoldenGate
SOURCEDATABASE_GGADMINUSERNAME=ggadmin
TARGETDATABASE_GGADMINUSERNAME=ggadmin
GOLDENGATEHUB_ADMINUSERNAME=oggadmin
GOLDENGATEHUB_URL=https://ogg21cora.xyz.xyz.xyz.com
GOLDENGATEHUB_SOURCEDEPLOYMENTNAME=ogg21cora
GOLDENGATEHUB_TARGETDEPLOYMENTNAME=ogg21cora
GOLDENGATEHUB_ALLOWSELSIGNEDCERTIFICATE=TRUE

# data pump
DATAPUMPSETTINGS_JOBMODE=SCHEMA
INCLUDEOBJECTS-1=owner:TEST
DATAPUMPSETTINGS_DATAPUMPPARAMETERS_IMPORTPARALLELISMDEGREE=2
DATAPUMPSETTINGS_DATAPUMPPARAMETERS_EXPORTPARALLELISMDEGREE=2
DATAPUMPSETTINGS_EXPORTDIRECTORYOBJECT_NAME=EXPORT_FS
DATAPUMPSETTINGS_EXPORTDIRECTORYOBJECT_PATH=EXPORT_FS on SOURCE
DATAPUMPSETTINGS_IMPORTDIRECTORYOBJECT_NAME=IMPORT_FS on TARGET mapped to ACFS Mount Point
DATAPUMPSETTINGS_IMPORTDIRECTORYOBJECT_PATH=EXPORT_FS on TARGET
```

Logical Online Migration to Exadata Cloud@Customer & Exadata On-Premises 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 will run swiftly and that no issues will be encountered. 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 itself. To 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 instances 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 30

zdmhost.xyx.xyz.xyz.com: Audit ID: 270
Job ID: 30
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"
```

Scheduled job execution start time: T06:31:44Z. Equivalent local time: 06:31:44

Current status: SUCCEEDED

Result file path: "/home/zdmuser/zdmbase/chkbase/scheduled/job-30.log"

Job execution start time: 06:32:09

Job execution end time: 06:34:33

Job execution elapsed time: 2 minutes 23 seconds

```
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 \
-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 \
zdmhost.xyz.xyz.com: Audit ID: 271
```

```
Enter source database administrative user "SYSTEM" password: *****
Enter source database administrative user "ggadmin" password: *****
Enter target database administrative user "SYSTEM" password: *****
Enter target database administrative user "ggadmin" password: *****
Enter Oracle GoldenGate hub administrative user "oggadmin" password: xyzxyz
Enter Data Pump encryption password: *****
```

Operation "zdmcli migrate database" scheduled with the job ID "31".

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

```
[zdmuser@zdmhost ~]$ $ZDM_HOME/bin/zdmcli query job -jobid 34
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 -sourcnode 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_TRANDATA_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_TRANDATA_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
```

Known Issues

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>

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
 - NFS
- 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>

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