

# Using Object Storage to Migrate Databases to Oracle Cloud Infrastructure Database as a Service (DBaaS)

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## Revision History

The following revisions have been made to this white paper since its initial publication:

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Date	Revision
October 26, 2018	Initial publication

You can find the most recent versions of the Oracle Cloud Infrastructure white papers at <https://cloud.oracle.com/iaas/technical-resources>.



## Table of Contents

Introduction	5
Steps to Migrate Oracle Database	5
Step 1: Back Up Oracle Database by Using RMAN	6
Perform a Full (Level 0) Backup	6
Perform an Incremental (Level 1) Backup	8
Step 2: Move the Oracle Database Backup to Object Storage	9
Data Transfer Disk	11
Data Transfer Appliance	11
Storage Gateway	11
CLI	12
Step 3: Create the Database Instance	14
Create the Database Instance	14
Connect to the Database Instance	15
Step 4: Configure the Database Cloud Backup Module	16
Generate an Auth Token	16
Download the Database Cloud Backup Module	16
Install the Database Cloud Backup Module	17
Step 5: Restore the Database from Object Storage as a Database Instance	17
Prepare the Database Instance	18
Adjust the Control File Location	18
Create System Backup to Tape Metadata Files	19
Restore the Control File	20
Catalog the Object Storage Backup Files	21



Restore the Database from Object Storage Backup	22
Recover the Database from the Object Storage Backup	25
Adjust the Log Files and Open the Database	25
Convert the Tablespace to Use Transparent Data Encryption	26
Update sqlnet.ora	26
Create the Key Store and Encryption Keys	26
Create Auto Login for the Wallet	27
Encrypt the Tablespace	27
Conclusion	27



## Introduction

Oracle Database is a multiple-model relational database management system that is widely used in many phases of business transactions and deployed in enterprises of all sizes to manage various forms of data. Oracle Database is commonly used for running Online Line Transaction Processing (OLTP), Data Warehousing (DW), and mixed OLTP and DW database workloads. Oracle Cloud Infrastructure provides a comprehensive set of services and tools for deploying Oracle Database workloads from on-premises to Oracle Cloud Infrastructure.

Oracle Cloud Infrastructure provides features to run Oracle Databases either directly in a Oracle Cloud Infrastructure Compute instance or in a Database as a Service (DBaaS) managed instance. DBaaS offers both autonomous and user-managed Oracle Database solutions. Autonomous databases are preconfigured, fully managed environments that are suitable for either transaction processing or for data warehouse workloads. User-managed solutions are bare metal, virtual machine, and Exadata DB systems that you can customize with the resources and settings that meet your needs. You can quickly provision a user-managed DB system or autonomous database. You have full access to the features and operations available with the database, but Oracle owns and manages the infrastructure.

This white paper describes in detail how to migrate Oracle Database workloads to Oracle Cloud Infrastructure as DBaaS user-managed Oracle Database instances. Migrating Oracle Database workloads to an Oracle Cloud Infrastructure Compute instance is detailed in a corresponding white paper, “Migrating Databases to Oracle Cloud Infrastructure Using Object Storage and a Data Transfer Service.”

## Steps to Migrate Oracle Database

Following are the high-level steps used to migrate Oracle Database to Oracle Cloud Infrastructure as a DBaaS database instance.

1. Back up Oracle Database by using Oracle Recovery Manager (RMAN).
2. Use one of the following data migration services and tools to copy the backup to Oracle Cloud Infrastructure Object Storage:
  - o Data Transfer Disk
  - o Data Transfer Appliance
  - o Storage Gateway
  - o Command Line Interface (CLI)
3. Launch the DBaaS database instance.

4. Download and configure the Oracle Database Cloud Backup Module in the DBaaS database instance.
5. Restore the backup from Object Storage as a DBaaS database instance.

## Step 1: Back Up Oracle Database by Using RMAN

Oracle RMAN performs and manages Oracle Database backups and restores. RMAN performs full and incremental backups (differential and cumulative) and maintains a catalog of the backups, which makes the restore process straightforward and dependable. RMAN can also duplicate, or clone, a database from a backup or from an active database.

### Perform a Full (Level 0) Backup

Run the following commands to take an encrypted, full backup of Oracle Database by using RMAN.

RMAN password-based encryption is used in this example, and the RMAN backup is encrypted by using the password `myPassword`. We recommend that you choose a unique and safe password and configure it by using the `SET ENCRYPTION ON IDENTIFIED BY '<password>'` only command while backing up the database. You use the same password when you decrypt the backup at the target instance during the restore.

```
$ rman target /
RMAN> SET ENCRYPTION ON IDENTIFIED BY 'myPassword' only;
executing command: SET encryption
RMAN>set compression algorithm 'medium';
executing command: SET compression
RMAN> run
{
  configure controlfile autobackup off;
  backup as compressed backupset
  device type disk
  tag dta_level0
  incremental level 0
  format '/u01/backups/Dbaas_fullbackup_%U'
  section size 24g
  database
  include current controlfile spfile
  plus archivelog
  format '/u01/backups/Dbaas_Al_fullbackup_%U';
}
old RMAN configuration parameters:
CONFIGURE CONTROLFILE AUTOBACKUP OFF;
new RMAN configuration parameters:
CONFIGURE CONTROLFILE AUTOBACKUP OFF;
new RMAN configuration parameters are successfully stored
```

```

Starting backup at 01-OCT-18
current log archived
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=267 device type=DISK
channel ORA_DISK_1: starting compressed archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set

channel ORA_DISK_1: backup set complete, elapsed time: 00:00:15
channel ORA_DISK_1: starting compressed incremental level 0 datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
including current control file in backup set
including current SPFILE in backup set
channel ORA_DISK_1: starting piece 1 at 01-OCT-18
channel ORA_DISK_1: finished piece 1 at 01-OCT-18
piece handle=/u01/backups/Dbaas_fullbackup_9jtej7e2_1_1 tag=DTA_LEVEL0 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
channel ORA_DISK_1: starting compressed incremental level 0 datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
including current SPFILE in backup set
channel ORA_DISK_1: starting piece 1 at 01-OCT-18
channel ORA_DISK_1: finished piece 1 at 01-OCT-18
piece handle=/u01/backups/Dbaas_fullbackup_9ktej7e4_1_1 tag=DTA_LEVEL0 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 01-OCT-18

Starting backup at 01-OCT-18
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting compressed archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=96 RECID=73 STAMP=988388805
channel ORA_DISK_1: starting piece 1 at 01-OCT-18
channel ORA_DISK_1: finished piece 1 at 01-OCT-18
piece handle=/u01/backups/Dbaas_A1_fullbackup_9ltej7e5_1_1 tag=DTA_LEVEL0
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 01-OCT-18
RMAN>

```

The preceding command places the backup files in the `/u01/backups` file system. After the backup is completed, perform the following steps:

1. Record the names of the controlfile and spfile backup files; you need them to successfully migrate the database. In the example, `Dbaas_fullbackup_9jtej7e2_1_1` and `Dbaas_fullbackup_9ktej7e4_1_1` are the controlfile and spfile names.

2. If the database is encrypted at the source, copy the `sqlnet.ora` file and the Transparent Data Encryption (TDE) wallet files along with the backup files. These files aren't copied as part of the RMAN backup process and must be copied separately.

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**Note:** As a best practice, do *not* copy TDE wallet file along with the database backup. We recommend copying these files separately for security reasons.

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Refer to the `sqlnet.ora` file for `ENCRYPTION_WALLET_LOCATION`.

```
$ cat $ORACLE_HOME/network/admin/sqlnet.ora
ENCRYPTION_WALLET_LOCATION =
  (SOURCE = (METHOD = FILE)
  (METHOD_DATA =
    (DIRECTORY = /etc/oracle/wallets/cdb1/)))
$ ls /etc/oracle/wallets/cdb1/
cwallet.sso cwallet.sso.lck ewallet.p12 ewallet.p12.lck
$
```

## Perform an Incremental (Level 1) Backup

Run the following commands to take an incremental backup of the database to capture the delta that has changed since the last full backup.

RMAN password-based encryption is used in this example, and the RMAN backup is encrypted by using the password `myPassword`. We recommend that you choose a unique and safe password and configure it by using the `SET ENCRYPTION ON IDENTIFIED BY '<password>'` only command when backing up the database. You use the same password when you decrypt the backup at the target instance during the restore.

```
$ rman target /
RMAN> SET ENCRYPTION ON IDENTIFIED BY 'myPassword' only;
executing command: SET encryption
RMAN>set compression algorithm 'medium';
executing command: SET compression
RMAN> run
{
  backup as compressed backupset
  device type disk
  tag dta_level1
  cumulative incremental level 1
  format '/u01/backups/Dbaas_Incremental_%U'
  section size 24g
  database
  include current controlfile spfile
  plus archivelog
  format '/u01/backups/Dbaas_A1_Incremental_%U';
}
Starting backup at 01-OCT-18
```

```

current log archived
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=38 device type=DISK
channel ORA_DISK_1: starting compressed archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
including current control file in backup set
including current SPFILE in backup set
channel ORA_DISK_1: starting piece 1 at 01-OCT-18
channel ORA_DISK_1: finished piece 1 at 01-OCT-18
piece handle=/u01/backups/Dbaas_Incremental_9ttej9j4_1_1 tag=DTA_LEVEL1 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
channel ORA_DISK_1: starting compressed incremental level 1 datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
including current SPFILE in backup set
channel ORA_DISK_1: starting piece 1 at 01-OCT-18
channel ORA_DISK_1: finished piece 1 at 01-OCT-18
piece handle=/u01/backups/Dbaas_Incremental_9utej9j6_1_1 tag=DTA_LEVEL1 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 01-OCT-18

Starting backup at 01-OCT-18
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting compressed archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=98 RECID=75 STAMP=988391015
channel ORA_DISK_1: starting piece 1 at 01-OCT-18
channel ORA_DISK_1: finished piece 1 at 01-OCT-18
piece handle=/u01/backups/Dbaas_Al_Incremental_9vtej9j7_1_1 tag=DTA_LEVEL1
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 01-OCT-18
RMAN>

```

After the backup is completed, record the names of the controlfile and spfile backup files; you need them to successfully migrate the database. In the preceding example, `Dbaas_Incremental_9ttej9j4_1_1` and `Dbaas_Incremental_9utej9j6_1_1` are the controlfile and spfile names.

## Step 2: Move the Oracle Database Backup to Object Storage

Oracle Cloud Infrastructure offers different solutions that let you migrate data securely. The type of service to use depends on various factors, including the size of the data and the type of network connectivity between your network and Oracle Cloud Infrastructure.

The following table provides our recommendations for the different use cases in which the data migration services can be used. If uploading data over the public internet takes longer than 1 week, we recommend that you consider using Data Transfer Appliance or Data Transfer Disk. Descriptions of the services follow the table.

Backup Dataset Size	Network Connectivity	Data Transfer Recommendations	Approximate Data Upload/Transfer Time
10 TB	100 Mbps	Data Transfer Appliance Data Transfer Disk	1 week
	1 Gbps	CLI Storage Gateway	22 hours
	10 Gbps	CLI Storage Gateway	2 hours
100 TB	100 Mbps	Data Transfer Appliance Data Transfer Disk	1 week
	1 Gbps	Data Transfer Appliance Data Transfer Disk	1 week
	10 Gbps	CLI Storage Gateway	24 hours
500 TB	100 Mbps	Data Transfer Appliance You need multiple transfer appliances. You can transfer only up to 150 TB of data using a single appliance.	1 week
	1 Gbps	Data Transfer Appliance You need multiple transfer appliances. You can transfer only up to 150 TB of data using a single appliance.	1 week
	10 Gbps	CLI	5 days
1 PB	All Bandwidths	Data Transfer Appliance You need multiple transfer appliances. You can transfer only up to 150 TB of data using a single appliance.	2 weeks



## Data Transfer Disk

Data Transfer Disk is an offline data migration service that lets you securely migrate data to Object Storage by using hard disk drives. You are responsible for purchasing the required number of hard disk drives, copying data to the drives, and shipping the drives to an Oracle data transfer site where the data is transferred to Object Storage. At the end of the data transfer process, the imported data is available in Object Storage.

See the [Data Transfer Disk documentation](#) for prerequisite tasks and detailed instructions for preparing and copying your data to the disk. After the package reaches the data transfer site, the database backup is copied to the bucket in Object Storage in your tenancy.

## Data Transfer Appliance

Data Transfer Appliance is an offline data migration service that lets you securely move petabyte-scale datasets to Object Storage by using a purpose-built storage appliance. You send your data as files on one or more secure, high-capacity transfer appliances to a data transfer site. Operators at the data transfer site upload the files to the designated Object Storage bucket in your tenancy.

See the [Data Transfer Appliance documentation](#) for prerequisite tasks and detailed instructions for preparing and copying your data to Data Transfer Appliance.

Consider the following points when using Data Transfer Appliance:

- You can transfer up to 150 TB of data by using a single transfer appliance. If you need to transfer more than 150 TB of data, you can request more than one appliance.
- The transfer appliance exposes a network file system (NFS) mount point. Copy the database backup to the transfer appliance by using normal file system commands.

## Storage Gateway

Oracle Cloud Infrastructure Storage Gateway helps you bridge your on-premises environment with Object Storage. By using Storage Gateway, any application that can store data on an NFS target can easily and seamlessly move data to Object Storage without having to first modify the application to uptake the REST API. Storage Gateway exposes an NFS mount point, which can be mounted to any host that supports an NFS client. Storage Gateway performs the NFS-to-REST API translations for you.

See the [Storage Gateway documentation](#) for prerequisite tasks and detailed instructions for downloading, installing, and configuring Storage Gateway. After Storage Gateway is configured and the file system is mounted, you copy your data using normal file system commands.

## CLI

The Oracle Cloud Infrastructure CLI is the primary command line-based utility for working with Oracle Cloud Infrastructure. You can use the CLI to bulk-upload files to Object Storage.

To use the CLI, you must first set it up. See the [CLI documentation](#) and follow the instructions to install and configure the CLI. After you set up the CLI utility, run the following command to bulk-upload the backup files. Replace `BUCKET` with your own value.

```
$ oci os object bulk-upload -bn BUCKET --src-dir /u01/backups
Uploaded
Dbaas_fullbackup_9etej7ae_1_1 [#####] 100%

{
  "skipped-objects": [],
  "upload-failures": {},
  "uploaded-objects": {
    ".DS_Store": {
      "etag": "7758F533654B3AD4E053C224C00A8851",
      "last-modified": "Wed, 03 Oct 2018 20:01:18 GMT",
      "opc-content-md5": "GUV3p+IL3Mevu3GPUCwTTA=="
    },
    "Dbaas_Al_Incremental_9mtej9gp_1_1": {
      "etag": "7758E327C0C22C9FE053C224C00AA0A3",
      "last-modified": "Wed, 03 Oct 2018 20:04:10 GMT",
      "opc-multipart-md5": "oHxUJyyXU2eYss79IwVqSQ==-3"
    },
    "Dbaas_Al_Incremental_9ntej9hs_1_1": {
      "etag": "77590B4F57FF5452E053C224C00AFB3E",
      "last-modified": "Wed, 03 Oct 2018 20:04:10 GMT",
      "opc-multipart-md5": "O5LQfTOSnPCGJczqWGXYUg==-3"
    },
    "Dbaas_Al_Incremental_9vtej9j7_1_1": {
      "etag": "7758B4C952871C14E053C224C00AF3C6",
      "last-modified": "Wed, 03 Oct 2018 20:01:19 GMT",
      "opc-content-md5": "WWMqDhILLiJqp/spXDCzkA=="
    },
    "Dbaas_Al_fullbackup_9ctej787_1_1": {
      "etag": "7759809A5BD712E053C224C00A5A7A",
      "last-modified": "Wed, 03 Oct 2018 20:05:26 GMT",
      "opc-multipart-md5": "EVF2qHEKXLWP4P/vHVn3AQ==-3"
    },
    "Dbaas_Al_fullbackup_9dtej79a_1_1": {
      "etag": "77597C3C67E2C892E053C224C00A6B4D",
      "last-modified": "Wed, 03 Oct 2018 20:04:10 GMT",
      "opc-multipart-md5": "8abalYmQdt4UTHPogstc0Q==-3"
    },
    "Dbaas_Al_fullbackup_9ltej7e5_1_1": {
      "etag": "77597BA1BFE9C856E053C224C00A5AE3",
      "last-modified": "Wed, 03 Oct 2018 20:01:18 GMT",
      "opc-content-md5": "whdmeH2IgUkIg3wNU7nPHQ=="
    }
  }
},
```



```
"Dbaas_Incremental_9otej9j0_1_1": {
  "etag": "775963A56EC7B0F8E053C224C00A7EBA",
  "last-modified": "Wed, 03 Oct 2018 20:01:22 GMT",
  "opc-content-md5": "oxVTBMNctrE/0EHbEud9NQ=="
},
"Dbaas_Incremental_9ttej9j4_1_1": {
  "etag": "77590AFB12335437E053C224C00A2205",
  "last-modified": "Wed, 03 Oct 2018 20:01:21 GMT",
  "opc-content-md5": "Xy+0/eSsjGrPHUGIiPGPYw=="
},
"Dbaas_Incremental_9utej9j6_1_1": {
  "etag": "77590B2B891A5449E053C224C00AF260",
  "last-modified": "Wed, 03 Oct 2018 20:01:18 GMT",
  "opc-content-md5": "w92G8sRrQDvqiKGeMTgYzw=="
},
"Dbaas_fullbackup_9etej7ae_1_1": {
  "etag": "7758DC09C5432481E053C224C00AE6A0",
  "last-modified": "Wed, 03 Oct 2018 20:07:01 GMT",
  "opc-multipart-md5": "TwaDpJZz8RYzv/jausz4+g==--4"
},
"Dbaas_fullbackup_9ftej7br_1_1": {
  "etag": "77590B4F58055452E053C224C00AFB3E",
  "last-modified": "Wed, 03 Oct 2018 20:04:13 GMT",
  "opc-multipart-md5": "yQMexo870f7fjDWe+7q8bg==--2"
},
"Dbaas_fullbackup_9gtej7ca_1_1": {
  "etag": "77598368BC82D873E053C224C00A4BF8",
  "last-modified": "Wed, 03 Oct 2018 20:04:03 GMT",
  "opc-multipart-md5": "J4vAoLYh/lQt9lXNRTqIQ==--2"
},
"Dbaas_fullbackup_9htej7d3_1_1": {
  "etag": "775927306D55766CE053C224C00A1F16",
  "last-modified": "Wed, 03 Oct 2018 20:07:00 GMT",
  "opc-multipart-md5": "zIoOv39cyh4n8RS+geyEyw==--2"
},
"Dbaas_fullbackup_9itej7dj_1_1": {
  "etag": "7758DD4C24FB21CAE053C224C00AE4F4",
  "last-modified": "Wed, 03 Oct 2018 20:06:49 GMT",
  "opc-multipart-md5": "dZELv7dJri+4CQ7ZMTItow==--2"
},
"Dbaas_fullbackup_9jtej7e2_1_1": {
  "etag": "7758C3105D5809E2E053C224C00AD626",
  "last-modified": "Wed, 03 Oct 2018 20:01:21 GMT",
  "opc-content-md5": "ZFjlnZj7iJT7eQAzwtfyMQ=="
},
"Dbaas_fullbackup_9ktej7e4_1_1": {
  "etag": "775911E586DE639EE053C224C00A8A93",
  "last-modified": "Wed, 03 Oct 2018 20:01:18 GMT",
  "opc-content-md5": "mKdmEoxuZ2vOKMv4nBdFBg=="
}
}
}
```

## Step 3: Create the Database Instance

You need the following information to create a database instance in Oracle Cloud Infrastructure:

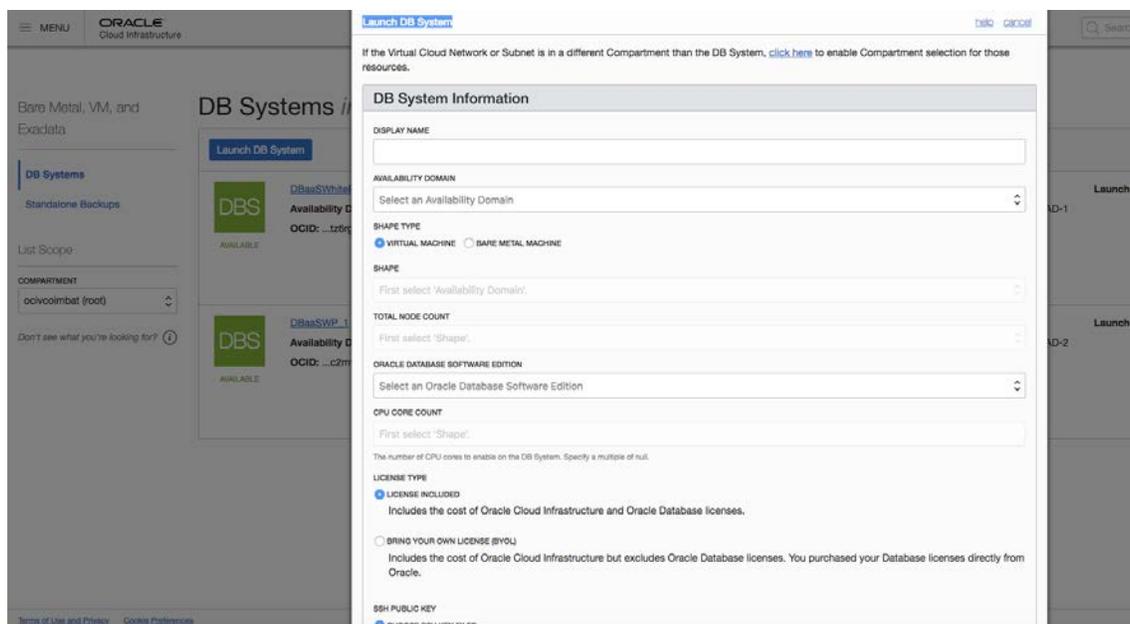
- The public key, in open SSH format, from the key pair that you plan to use to connect to the DB system via SSH. This key is used to authenticate your SSH sessions. If you don't have an SSH key pair, you can use the following command to create a new SSH key pair:

```
$ cat $ORACLE_HOME/network/admin/sqlnet.ora
ENCRYPTION_WALLET_LOCATION =
  (SOURCE = (METHOD = FILE)
  (METHOD_DATA =
    (DIRECTORY = /etc/oracle/wallets/cdb1/)))
$ ls /etc/oracle/wallets/cdb1/
cwallet.sso cwallet.sso.lck ewallet.p12 ewallet.p12.lck
$
```

- The name of a virtual cloud network (VCN) in which to launch the database instance. For information about setting up cloud networks, see [Overview of Networking](#).

## Create the Database Instance

Sign in to the Oracle Cloud Infrastructure Console, open the menu, click **Bare Metal, VM, and Exadata**, and then create a new DB System. The system prompts you to enter the necessary information to create the instance. Remember to choose the public key of the SSH key pair that you created earlier.



For detailed instructions, see [Managing Bare Metal and Virtual Machine DB Systems](#).

Remember that the name and version of the Oracle Database that you are creating must be the same as the name and version of the Oracle Database in the source database instance.

Database Information
DATABASE NAME
<input type="text" value="DBWP"/>
DATABASE VERSION
<input type="text" value="12.2.0.1"/>
PDB NAME (Optional)
<input type="text"/>

## Connect to the Database Instance

After you create the database instance, use the following commands to set up permissions and to connect to the instance:

```
$ chmod 400 dbaasinstance_rsa
$ ssh -i dbaasinstance_rsa opc@PUBLIC_IP_ADDRESS
Last failed login: Fri Sep 28 02:03:25 GMT 2018 from 209.141.40.49 on ssh:notty
There were 1 failed login attempts since the last successful login.
Last login: Wed Sep 26 22:57:07 2018 from 160.34.93.141
$
```

---

**Note:** Replace PUBLIC\_IP\_ADDRESS with public IP address of the database instance that you just created.

---

For detailed instructions, see [Connecting to a DB System](#).

After you log in to the database instance, change the password for the oracle and grid users. These users are created as part of the database installation process.

```
# passwd oracle
Changing password for user oracle.
New password:
Retype new password:
passwd: all authentication tokens updated successfully.
# passwd grid
Changing password for user grid.
New password:
Retype new password:
passwd: all authentication tokens updated successfully.
#
```

## Step 4: Configure the Database Cloud Backup Module

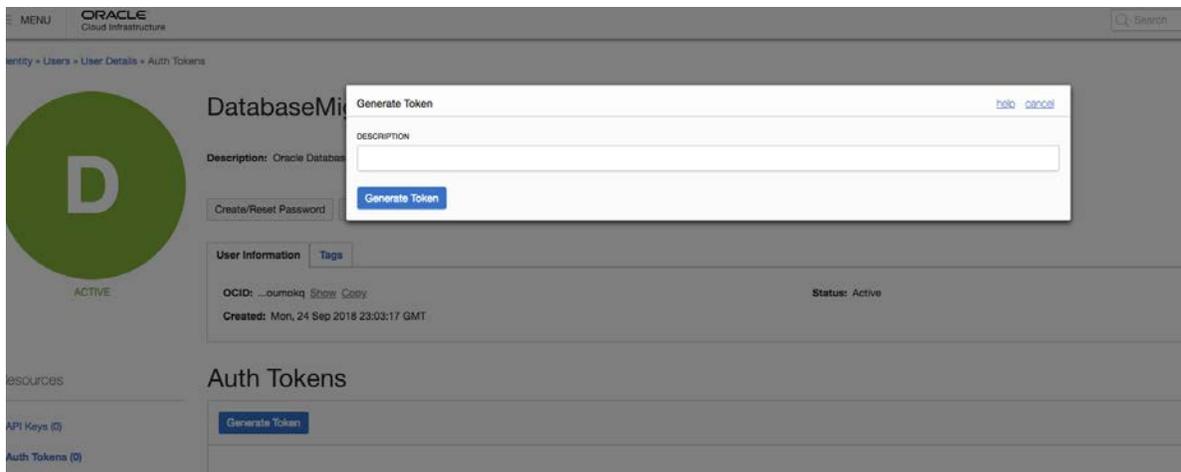
The Oracle Database Cloud Backup Module makes it possible to perform cloud backups and restores. The module is a system backup to tape (SBT) interface that's integrated with RMAN, so you can use standard RMAN commands for all backup, restore, recovery, and maintenance operations.

### Generate an Auth Token

The Oracle Database Cloud Backup Module uses the Swift protocol to interact with Object Storage. Swift access to Object Storage is authenticated by using *auth tokens*.

To generate an auth token, sign in to the Oracle Cloud Infrastructure Console and perform the following steps:

1. Open the menu and navigate to **Identity** and then **Users**.
2. Select your user ID and then select **Auth Tokens**.
3. Click **Generate Token** to create authentication token.



For more information about generating an auth token, see the [documentation](#).

### Download the Database Cloud Backup Module

Download the Database Cloud Backup Module from [Oracle Technology Network \(OTN\)](#) and upload it to the `/tmp` directory of the target instance. Then, unzip the `opc_installer.zip` file.

## Install the Database Cloud Backup Module

Run the following commands to install the Database Cloud Backup Module. Replace `USER_ID`, `BUCKET_NAME`, `AUTH_TOKEN`, `REGION`, and `TENANCY` with your own values.

```
# mkdir -p /home/oracle/cbm/cbm_lib
# export vcbm_lib=/home/oracle/cbm/cbm_lib
# export vcbm_config=/home/oracle/cbm/cbm_config
# export vcbm_wallet=/home/oracle/cbm/cbm_wallet
# su - oracle
$ cd /tmp/opc_installer
$ $ORACLE_HOME/jdk/bin/java -jar opc_install.jar -opcId USER_ID -
opcPass 'AUTH_TOKEN' -container BUCKET_NAME -walletDir $vcbm_wallet -libDir $vcbm_lib
-configfile $vcbm_config -host
https://swiftobjectstorage.REGION.oraclecloud.com/v1/TENANCY
Oracle Database Cloud Backup Module Install Tool, build 12.2.0.1.0DBBKPCSBP_2018-06-
12
Oracle Database Cloud Backup Module credentials are valid.
Backups would be sent to container <bucket_name>
Oracle Database Cloud Backup Module wallet created in directory
/home/oracle/cbm/cbm_wallet.
Oracle Database Cloud Backup Module initialization file /home/oracle/cbm/cbm_config
created.
Downloading Oracle Database Cloud Backup Module Software Library from
file opc_linux64.zip.
Download Completed.
$
```

## Step 5: Restore the Database from Object Storage as a Database Instance

If the database being migrated is encrypted at the source, download the `sqlnet.ora` and TDE wallet files that you copied during the backup process and place them in the wallet location. Create an auto login wallet before proceeding with the database restore process. Ensure that `sqlnet.ora` has the right `ENCRYPTION_WALLET_LOCATION`.

```
$ cat $ORACLE_HOME/network/admin/sqlnet.ora
ENCRYPTION_WALLET_LOCATION
=(SOURCE=(METHOD=FILE)(METHOD_DATA=(DIRECTORY=/etc/oracle/wallets/cdb1/)))
$ cd /etc/oracle/wallets/cdb1
$ ls
cwallet.sso cwallet.sso.lck ewallet.p12 ewallet.p12.lck
$
```

## Prepare the Database Instance

To prepare DBaaS database instance for the restore, shut down the database and delete all the files that belong to the database.

1. Log in as the oracle user and shut down the database.
2. Log in as grid user and use `asmcmd` to locate and delete all the files under the `+DATA/<db_unique_name>` and `+RECO/<db_unique_name>` directories.

---

**Note:** Do *not* delete the parameter file under the `+DATA` directory.

---

```
$ . oraenv
ORACLE_SID = [DBWP] ? DBWP
The Oracle base has been set to /u01/app/oracle
$ ls /opt/oracle/dcs/commonstore/wallets/tde
DBWP_iad2gg
$ export ORACLE_UNQNAME=DBWP_iad2gg
$ srvctl stop database -d DBWP_iad2gg
$ rm /opt/oracle/dcs/commonstore/wallets/tde/DBWP_iad2gg/*
$ rm /u01/app/oracle/product/12.2.0.1/dbhome_1/dbs/orapwDBWP
$ su - grid
Password:
[grid@dbaas ~]$ asmcmd ls +DATA/DBWP_iad2gg
6EB3D42F8AC402E5E053060011AC07BB/
7731B571BB7EF5A2E0530201000A5603/
7731CB4EF5396A28E0530201000A0832/
DATAFILE/
PARAMETERFILE/
TEMPFILE/
[grid@dbaas ~]$ asmcmd rm -rf +DATA/DBWP_iad2gg/6EB3D42F8AC402E5E053060011AC07BB
[grid@dbaas ~]$ asmcmd rm -rf +DATA/DBWP_iad2gg/7731B571BB7EF5A2E0530201000A5603
[grid@dbaas ~]$ asmcmd rm -rf +DATA/DBWP_iad2gg/7731CB4EF5396A28E0530201000A0832
[grid@dbaas ~]$ asmcmd rm -rf +DATA/DBWP_iad2gg/DATAFILE
[grid@dbaas ~]$ asmcmd rm -rf +DATA/DBWP_iad2gg/TEMPFILE
[grid@dbaas ~]$ asmcmd ls +RECO/DBWP_iad2gg
ARCHIVELOG/
AUTOBACKUP/
CONTROLFILE/
ONLINELOG/
[grid@dbaas ~]$ asmcmd rm -rf +RECO/DBWP_iad2gg/*
[grid@dbaas ~]$
```

## Adjust the Control File Location

Run the following command to adjust the controlfile location before restoring the controlfile:

```
$ sqlplus / as sysdba
SQL*Plus: Release 12.2.0.1.0 Production on Tue Oct 2 18:02:31 2018
Copyright (c) 1982, 2016, Oracle. All rights reserved.
```

```

Connected to an idle instance.
SQL> startup force nomount;
ORACLE instance started.

Total System Global Area 1.6106E+10 bytes
Fixed Size                8811784 bytes
Variable Size             2281704184 bytes
Database Buffers         1.3791E+10 bytes
Redo Buffers              24739840 bytes
SQL> alter system set control_files='+RECO' scope=spfile sid='*';
System altered.
SQL>

```

## Create System Backup to Tape Metadata Files

In this example, the backup files were created directly by RMAN without using the Database Cloud Backup Module at the source. For backups generated without the Database Cloud Backup Module, you must create system backup to tape (SBT) metadata files to restore the backup from Object Storage by using the Database Cloud Backup Module.

Run the following command to generate SBT metadata for the backup files that are stored in Object Storage:

```

$ rman target /
RMAN> startup nomount force;
RMAN> set decryption identified by 'myPassword';
executing command: SET decryption
using target database control file instead of recovery catalog
RMAN>run {
allocate channel t1 device type sbt
parms='SBT_LIBRARY=/home/oracle/cbm/cbm_lib/libopc.so, SBT_PARAMS=(OPC_PFILE=/home/ora
cle/cbm/cbm_config)';
send channel t1 '
export backuppiece Dbaas_Al_fullbackup_9ctej787_1_1;
export backuppiece Dbaas_Al_fullbackup_9dtej79a_1_1;
export backuppiece Dbaas_Al_fullbackup_9ltej7e5_1_1;
export backuppiece Dbaas_Al_Incremental_9mtej9gp_1_1;
export backuppiece Dbaas_Al_Incremental_9ntej9hs_1_1;
export backuppiece Dbaas_Al_Incremental_9vtej9j7_1_1;
export backuppiece Dbaas_fullbackup_9etej7ae_1_1;
export backuppiece Dbaas_fullbackup_9ftej7br_1_1;
export backuppiece Dbaas_fullbackup_9gtej7ca_1_1;
export backuppiece Dbaas_fullbackup_9htej7d3_1_1;
export backuppiece Dbaas_fullbackup_9itej7dj_1_1;
export backuppiece Dbaas_fullbackup_9jtej7e2_1_1;
export backuppiece Dbaas_fullbackup_9ktej7e4_1_1;
export backuppiece Dbaas_Incremental_9otej9j0_1_1;
export backuppiece Dbaas_Incremental_9ttej9j4_1_1;
export backuppiece Dbaas_Incremental_9utej9j6_1_1;
';
}

```

```
allocated channel: t1
channel t1: SID=25 device type=SBT_TAPE
channel t1: Oracle Database Backup Service Library VER=12.2.0.2

sent command to channel: t1
released channel: t1
RMAN>
```

The following SBT metadata files are generated in Object Storage:

- sbt\_catalog/Dbaas\_Al\_fullbackup\_9ctej787\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Al\_fullbackup\_9dtej79a\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Al\_fullbackup\_9ltej7e5\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Al\_Incremental\_9mtej9gp\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Al\_Incremental\_9ntej9hs\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Al\_Incremental\_9vtej9j7\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_fullbackup\_9etej7ae\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_fullbackup\_9ftej7br\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_fullbackup\_9gtej7ca\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_fullbackup\_9htej7d3\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_fullbackup\_9itej7dj\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_fullbackup\_9jtej7e2\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_fullbackup\_9ktej7e4\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Incremental\_9otej9j0\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Incremental\_9ttej9j4\_1\_1/metadata.xml
- sbt\_catalog/Dbaas\_Incremental\_9utej9j6\_1\_1/metadata.xml

## Restore the Control File

Run the following command to restore the database controlfile from the incremental controlfile backup. Use the same password (in `set decryption`) that you used to encrypt the backup on the source instance.

```
$ rman target /
RMAN> set decryption identified by 'myPassword';
RMAN >run {
  allocate channel c1 device type sbt
PARMS 'SBT_LIBRARY=/home/oracle/cbm/cbm_lib/libopc.so, SBT_PARMS=(OPC_PFILE=/home/oracle/cbm/cbm_config)';
  restore controlfile from 'Dbaas_Incremental_9ttej9j4_1_1';
}
allocated channel: c1
channel c1: SID=158 device type=SBT_TAPE
channel c1: Oracle Database Backup Service Library VER=12.2.0.2
Starting restore at 02-OCT-18

channel c1: restoring control file
channel c1: restore complete, elapsed time: 00:00:03
```

```
output file name=+RECO/DBWP_IAD2GG/CONTROLFILE/current.262.988483247
Finished restore at 02-OCT-18
released channel: c1
RMAN> alter database mount;
Statement processed
RMAN>
```

## Catalog the Object Storage Backup Files

Run the following commands to catalog the Object Storage backup files:

```
RMAN>
new RMAN configuration parameters:
CONFIGURE CHANNEL DEVICE
TYPE 'SBT_TAPE' PARMS 'SBT_LIBRARY=/home/oracle/cbm/cbm_lib/libopc.so, SBT_PARMS=(OP
C_PFILE=/home/oracle/cbm/cbm_config)';
new RMAN configuration parameters are successfully stored

allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: SID=262 device type=SBT_TAPE
channel ORA_SBT_TAPE_1: Oracle Database Backup Service Library VER=12.2.0.2
specification does not match any backup in the repository

released channel: ORA_DISK_1
released channel: ORA_SBT_TAPE_1
allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: SID=16 device type=SBT_TAPE
channel ORA_SBT_TAPE_1: Oracle Database Backup Service Library VER=12.2.0.2
cataloged backup piece
backup piece handle=Dbaas_Al_fullbackup_9ctej787_1_1 RECID=208 STAMP=988485332
cataloged backup piece
backup piece handle=Dbaas_Al_fullbackup_9dtej79a_1_1 RECID=209 STAMP=988485332
cataloged backup piece
backup piece handle=Dbaas_Al_fullbackup_9ltej7e5_1_1 RECID=210 STAMP=988485332
cataloged backup piece
backup piece handle=Dbaas_Al_Incremental_9mtej9gp_1_1 RECID=211 STAMP=988485333
cataloged backup piece
backup piece handle=Dbaas_Al_Incremental_9ntej9hs_1_1 RECID=212 STAMP=988485333
cataloged backup piece
backup piece handle=Dbaas_Al_Incremental_9vtej9j7_1_1 RECID=213 STAMP=988485334
cataloged backup piece
backup piece handle=Dbaas_fullbackup_9etej7ae_1_1 RECID=214 STAMP=988485334
cataloged backup piece
backup piece handle=Dbaas_fullbackup_9ftej7br_1_1 RECID=215 STAMP=988485334
cataloged backup piece
backup piece handle=Dbaas_fullbackup_9gtej7ca_1_1 RECID=216 STAMP=988485335
cataloged backup piece
backup piece handle=Dbaas_fullbackup_9htej7d3_1_1 RECID=217 STAMP=988485335
cataloged backup piece
backup piece handle=Dbaas_fullbackup_9itej7dj_1_1 RECID=218 STAMP=988485336
cataloged backup piece
backup piece handle=Dbaas_fullbackup_9jtej7e2_1_1 RECID=219 STAMP=988485336
cataloged backup piece
```

```

backup piece handle=Dbaas_fullbackup_9ktej7e4_1_1 RECID=220 STAMP=988485337
cataloged backup piece
backup piece handle=Dbaas_Incremental_9otej9j0_1_1 RECID=221 STAMP=988485337
cataloged backup piece
backup piece handle=Dbaas_Incremental_9ttej9j4_1_1 RECID=222 STAMP=988485338
cataloged backup piece
backup piece handle=Dbaas_Incremental_9utej9j6_1_1 RECID=223 STAMP=988485338
RMAN> list backup summary;

```

List of Backups

=====

Key	TY	LV	S	Device	Type	Completion Time	#Pieces	#Copies	Compressed	Tag
192	B	A	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
193	B	A	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
194	B	A	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
195	B	A	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL1
196	B	A	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL1
197	B	A	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL1
198	B	0	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
199	B	0	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
200	B	0	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
201	B	0	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
202	B	0	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
203	B	0	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
204	B	0	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL0
205	B	1	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL1
206	B	1	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL1
207	B	1	A	SBT_TAPE		02-OCT18	1	1	YES	DTA_LEVEL1

RMAN>

## Restore the Database from Object Storage Backup

Run the following commands to restore the database from the Object Storage backup. Use the same password (in set decryption) that you used to encrypt the backup on the source instance.

```

$ rman target /
RMAN> set decryption identified by 'myPassword';
RMAN >run {
set newname for database to new;
restore device type sbt database;
switch datafile all;
switch tempfile all;
}
executing command: SET NEWNAME
Starting restore at 02-OCT-18
released channel: ORA_SBT_TAPE_1
allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: SID=16 device type=SBT_TAPE
channel ORA_SBT_TAPE_1: Oracle Database Backup Service Library VER=12.2.0.2

channel ORA_SBT_TAPE_1: starting datafile backup set restore
channel ORA_SBT_TAPE_1: specifying datafile(s) to restore from backup set

```

```
channel ORA_SBT_TAPE_1: restoring datafile 00001 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00003 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00004 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00007 to +DATA
channel ORA_SBT_TAPE_1: reading from backup piece DbaaS_fullbackup_9etej7ae_1_1
channel ORA_SBT_TAPE_1: piece handle=DbaaS_fullbackup_9etej7ae_1_1 tag=DTA_LEVEL0
channel ORA_SBT_TAPE_1: restored backup piece 1
channel ORA_SBT_TAPE_1: restore complete, elapsed time: 00:00:25
channel ORA_SBT_TAPE_1: starting datafile backup set restore
channel ORA_SBT_TAPE_1: specifying datafile(s) to restore from backup set
channel ORA_SBT_TAPE_1: restoring datafile 00005 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00006 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00008 to +DATA
channel ORA_SBT_TAPE_1: reading from backup piece DbaaS_fullbackup_9gtej7ca_1_1
channel ORA_SBT_TAPE_1: piece handle=DbaaS_fullbackup_9gtej7ca_1_1 tag=DTA_LEVEL0
channel ORA_SBT_TAPE_1: restored backup piece 1
channel ORA_SBT_TAPE_1: restore complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_1: starting datafile backup set restore
channel ORA_SBT_TAPE_1: specifying datafile(s) to restore from backup set
channel ORA_SBT_TAPE_1: restoring datafile 00009 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00010 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00011 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00012 to +DATA
channel ORA_SBT_TAPE_1: reading from backup piece DbaaS_fullbackup_9ftej7br_1_1
channel ORA_SBT_TAPE_1: piece handle=DbaaS_fullbackup_9ftej7br_1_1 tag=DTA_LEVEL0
channel ORA_SBT_TAPE_1: restored backup piece 1
channel ORA_SBT_TAPE_1: restore complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_1: starting datafile backup set restore
channel ORA_SBT_TAPE_1: specifying datafile(s) to restore from backup set
channel ORA_SBT_TAPE_1: restoring datafile 00016 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00017 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00018 to +DATA
channel ORA_SBT_TAPE_1: reading from backup piece DbaaS_fullbackup_9htej7d3_1_1
channel ORA_SBT_TAPE_1: piece handle=DbaaS_fullbackup_9htej7d3_1_1 tag=DTA_LEVEL0
channel ORA_SBT_TAPE_1: restored backup piece 1
channel ORA_SBT_TAPE_1: restore complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_1: starting datafile backup set restore
channel ORA_SBT_TAPE_1: specifying datafile(s) to restore from backup set
channel ORA_SBT_TAPE_1: restoring datafile 00019 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00020 to +DATA
channel ORA_SBT_TAPE_1: restoring datafile 00021 to +DATA
channel ORA_SBT_TAPE_1: reading from backup piece DbaaS_fullbackup_9itej7dj_1_1
channel ORA_SBT_TAPE_1: piece handle=DbaaS_fullbackup_9itej7dj_1_1 tag=DTA_LEVEL0
channel ORA_SBT_TAPE_1: restored backup piece 1
channel ORA_SBT_TAPE_1: restore complete, elapsed time: 00:00:15
Finished restore at 02-OCT-18
```

```
datafile 1 switched to datafile copy
input datafile copy RECID=21 STAMP=988485775 file
name=+DATA/DBWP_IAD2GG/DATAFILE/system.263.988485691 datafile 3 switched to datafile
copy
input datafile copy RECID=22 STAMP=988485775 file
name=+DATA/DBWP_IAD2GG/DATAFILE/sysaux.274.988485691
datafile 4 switched to datafile copy
```

```
input datafile copy RECID=23 STAMP=988485776 file
name=+DATA/DBWP_IAD2GG/DATAFILE/undotbs1.262.988485691
datafile 5 switched to datafile copy
input datafile copy RECID=24 STAMP=988485776 file
name=+DATA/DBWP_IAD2GG/75C696F459B214F1E0530F00000A9CA5/DATAFILE/system.272.988485715
datafile 6 switched to datafile copy
input datafile copy RECID=25 STAMP=988485776 file
name=+DATA/DBWP_IAD2GG/75C696F459B214F1E0530F00000A9CA5/DATAFILE/sysaux.275.988485715
datafile 7 switched to datafile copy
input datafile copy RECID=26 STAMP=988485776 file
name=+DATA/DBWP_IAD2GG/DATAFILE/users.261.988485691
datafile 8 switched to datafile copy
input datafile copy RECID=27 STAMP=988485776 file
name=+DATA/DBWP_IAD2GG/75C696F459B214F1E0530F00000A9CA5/DATAFILE/undotbs1.271.988485715
datafile 9 switched to datafile copy
input datafile copy RECID=28 STAMP=988485776 file
name=+DATA/DBWP_IAD2GG/75C6A557A85A1D91E0530F00000AA53A/DATAFILE/system.273.988485731
datafile 10 switched to datafile copy
input datafile copy RECID=29 STAMP=988485776 file
name=+DATA/DBWP_IAD2GG/75C6A557A85A1D91E0530F00000AA53A/DATAFILE/sysaux.270.988485731
datafile 11 switched to datafile copy
input datafile copy RECID=30 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/75C6A557A85A1D91E0530F00000AA53A/DATAFILE/undotbs1.268.988485731
datafile 12 switched to datafile copy
input datafile copy RECID=31 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/75C6A557A85A1D91E0530F00000AA53A/DATAFILE/users.267.988485731
datafile 16 switched to datafile copy
input datafile copy RECID=32 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/760AE48A954574F3E0530F00000A94CB/DATAFILE/system.265.988485745
datafile 17 switched to datafile copy
input datafile copy RECID=33 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/760AE48A954574F3E0530F00000A94CB/DATAFILE/sysaux.266.988485745
datafile 18 switched to datafile copy
input datafile copy RECID=34 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/760AE48A954574F3E0530F00000A94CB/DATAFILE/undotbs1.279.988485745
datafile 19 switched to datafile copy
input datafile copy RECID=35 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/760AE48A954674F3E0530F00000A94CB/DATAFILE/system.283.988485761
datafile 20 switched to datafile copy
input datafile copy RECID=36 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/760AE48A954674F3E0530F00000A94CB/DATAFILE/sysaux.282.988485761
datafile 21 switched to datafile copy
input datafile copy RECID=37 STAMP=988485777 file
name=+DATA/DBWP_IAD2GG/760AE48A954674F3E0530F00000A94CB/DATAFILE/undotbs1.284.988485761
renamed tempfile 1 to +DATA in control file
renamed tempfile 2 to +DATA in control file
renamed tempfile 3 to +DATA in control file
renamed tempfile 4 to +DATA in control file
renamed tempfile 5 to +DATA in control file
RMAN>
```

## Recover the Database from the Object Storage Backup

Run the following command to recover the database:

```
RMAN> list backup of archivelog all;

List of Backup Sets
=====
BS Key   Size          Device Type Elapsed Time Completion Time
-----
194      Unknown      SBT_TAPE    00:00:00     02-OCT-18
          BP Key: 210   Status: AVAILABLE Compressed: YES Tag: DTA_LEVEL0
          Handle:
Dbaas_Al_fullbackup_9ctej787_1_1 Media: swiftobjectstorage...com/v1/ocivcoimbat/OracleDatabaseWhitepaper
List of Archived Logs in backup set 194
  Thrd Seq      Low SCN      Low Time     Next SCN     Next Time
  ----
1      96          2203328     01-OCT-18   2203410     01-OCT-18
RMAN> run { set until sequence 96 thread 1;}
executing command: SET until clause
RMAN> recover device type sbt database;
Starting recover at 02-OCT-18
released channel: ORA_SBT_TAPE_1
allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: SID=16 device type=SBT_TAPE
channel ORA_SBT_TAPE_1: Oracle Database Backup Service Library VER=12.2.0.2
starting media recovery

media recovery complete. elapsed time: 00:00:01
Finished recover at 02-OCT-18
RMAN>
```

## Adjust the Log Files and Open the Database

Run the following commands to adjust the log files and open the database:

```
RMAN> alter database rename
file '/u01/app/oracle/oradata/cdb1/redo03.log' to '+RECO';
using target database control file instead of recovery catalog
Statement processed
RMAN> alter database rename
file '/u01/app/oracle/oradata/cdb1/redo02.log' TO '+RECO';
Statement processed
RMAN> alter database rename
file '/u01/app/oracle/oradata/cdb1/redo01.log' to '+RECO';
Statement processed
RMAN> alter database enable block change tracking using file '+DATA';
Statement processed
RMAN> alter database open resetlogs;
Statement processed
RMAN>
```

## Convert the Tablespace to Use Transparent Data Encryption

**Note:** You can skip this step if the database being migrated is encrypted at source and if the wallet files and `sqlnet.ora` files are already copied as part of the restore process (as described in the database restore section).

If the on-premises databases being migrated to Oracle Cloud Infrastructure are not encrypted at source, after the migration is completed, use the following high-level steps to encrypt the tablespace with TDE:

1. Add the master key for the container database (CDB) and the pluggable databases (PDBs) to the wallet.
2. Encrypt the tablespace. Follow the steps to set up TDE encryption to encrypt the tablespace.

### Update `sqlnet.ora`

Update the `sqlnet.ora` file to reflect the correct wallet location.

```
$ cat $ORACLE_HOME/network/admin/sqlnet.ora
ENCRYPTION_WALLET_LOCATION
=(SOURCE=(METHOD=FILE)(METHOD_DATA=(DIRECTORY=/u01/app/oracle/admin/DBWP_iad2gg/xdw_w
allet)))
$
```

### Create the Key Store and Encryption Keys

Run the following commands to create key store and encryption keys:

```
$ sqlplus / as sysdba
SQL> administer key management create
keystore '/u01/app/oracle/admin/DBWP_iad2gg/xdw_wallet' identified
by "WALLET_PASSWORD";
SQL> administer key management set keystore open identified by "WALLET_PASSWORD";
SQL> administer key management set encryption key identified
by "WALLET_PASSWORD" with backup;
SQL>
```

Replace `WALLET_PASSWORD` with your own values. The `WALLET_PASSWORD` is the same password that you specified as the admin password when you created the DBaaS database instance in the Oracle Cloud Infrastructure Console.



## Create Auto Login for the Wallet

Run the following command to create auto login for the wallet:

```
SQL> administer key management create auto_login keystore from  
keystore '/u01/app/oracle/admin/CDB/wallet' identified by "WALLET_PASSWORD";  
SQL>
```

Replace `WALLET_PASSWORD` with your own values. The `WALLET_PASSWORD` is the same password that you specified as the admin password when you created the DBaaS database instance in the Oracle Cloud Infrastructure Console.

## Encrypt the Tablespace

Now you can encrypt the user-created tablespace in the database. The following command performs an online conversion of the user's tablespace:

```
SQL> alter tablespace users encryption online using 'AES256' encrypt;  
SQL> shutdown immediate;  
SQL> startup;
```

## Conclusion

By migrating your Oracle Databases to Oracle Cloud Infrastructure, you can take advantage of a world-class database running on an enterprise-class cloud platform. This white paper provided detailed instructions for migrating and deploying Oracle Database from on-premises to Oracle Cloud Infrastructure as a DBaaS database instance. The type of data migration service to use depends on the size of the database and the network connectivity between the source instance and Object Storage. For fast and secure database migration, it is critical to choose the appropriate data migration services. By following the steps outlined in this paper, you can migrate Oracle Databases to Oracle Cloud Infrastructure securely with minimal downtime



**Oracle Corporation, World Headquarters**  
500 Oracle Parkway  
Redwood Shores, CA 94065, USA

**Worldwide Inquiries**  
Phone: +1.650.506.7000  
Fax: +1.650.506.7200

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**Integrated Cloud Applications & Platform Services**

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November 2018  
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