



Oracle Database Protection on Windows Servers using Dell EqualLogic Storage and Tools

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Revisions

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Executive Summary

Backup and Recovery is one of the most essential aspects of Oracle database administration. Backing up important data protects against many types of failures. During backup, copies of the Oracle data are made and then used for development and testing as well as restoring in the event of a data loss or disaster. This white paper describes:

- How to use Dell EqualLogic hardware-based SAN snapshots for an automated Oracle database backup and recovery solution tailored specifically for Windows environments using PowerShell scripting
- The Oracle ODP.NET and RMAN utilities
- EqualLogic PS Series iSCSI storage and Host Integration Tools for Windows V4.7



1 Introduction

With database sizes growing from gigabytes to terabytes, it is a challenge for database and storage administrators to implement a reliable, efficient, and cost effective backup and recovery solution that protects business-critical applications against downtime and disaster. An efficient backup and recovery solution does not have an impact on application performance, and reduces the Recovery Point Objective (RPO) and Recovery Time Objective (RTO). Storage snapshot technology allows quick backup and restore for large amounts of data without jeopardizing data integrity and performance.

This white paper addresses the backup and recovery challenges of providing continuous protection for Oracle databases running on Windows Server. It also demonstrates using EqualLogic Host Integration Tools for Microsoft (particularly the HIT/Microsoft Auto-Snapshot Manager and PowerShell Integration tools, as well as Oracle RMAN and ODP.NET) to perform the following operations.

- Create an application consistent snap shot of a running Oracle database
- Offload RMAN backup operation to backup server
- Perform a point-in-time recovery of database using EqualLogic snapshots.
- Perform complete database recovery with zero data loss



2 Technology overview

This section details the various technologies used in the solutions presented in this white paper. The primary toolsets involve EqualLogic Host Integration tools, Oracle's Database, ODP.NET utility, and Recovery Manager (RMAN).

Note: A detailed discussion about Oracle Database, ODP.NET, and RMAN is beyond the scope of this document. See the Oracle Documentation Library at http://docs.oracle.com/cd/E11882_01/index.htm for information on these subjects.

2.1 EqualLogic Host Integration Tools Microsoft Edition

The EqualLogic Host Integration Tools Microsoft Edition (HIT/Microsoft) provides an administrator with the ability to manage and configure PS Series storage arrays from the servers that use them. The HIT/Microsoft toolkit allows administrators to perform a wide variety of tasks such as initializing new arrays, creating application consistent snapshots, and scripting management operations. The EqualLogic Host Tools are available to all EqualLogic customers at no additional cost.

Table 1 HIT/Microsoft components used in this document

Installed component	Installed features and services	Description
Dell EqualLogic Auto-Snapshot Manager (ASM/ME)	Service: EqlASMAgent Application: EQLASMAApp.exe	Centralized management of Windows hosts connected to EqualLogic SANs. Automated protection and recovery utilizing Smart Copies (snapshots, clones, and replicas). Alternate CLI facilitates, custom operations and scripting.
PowerShell Tools	Libraries: EQLPSTools.dll, EQLASMTTools.dll*, EQLPSArrayTools.dll*, EQLMpioPSTools.dll*	Manages one or more PS Series groups through a comprehensive set of PowerShell cmdlets. *Introduced with HIT/Microsoft version 4.7
Dell EqualLogic Storage Management Provider (SMP)	Service: EqlSMPHost	Manages EqualLogic storage directly through native Windows storage interfaces such as PowerShell cmdlets, File Services UI in the Windows Server 2012 Server Manager console, or the standard Windows Management Instrumentation API.

For more information on installing and using the EqualLogic HIT kit, go to the HIT/Microsoft installation directory at C:\Program Files\EqualLogic\Doc\ for the following files or download the guide at: https://eqlsupport.dell.com/support/download_file.aspx?id=2484.



2.2 Oracle backup and recovery

The purpose of backup and recovery is to protect the database against loss or corruption of data and to reconstruct the database to a specific state after a data loss.

The recovery process includes two major types of activities: restoring and recovering. Restoring is the process of copying a backup into place to be used by the database. This is necessary, for example, if a physical disk fails due to hardware problems or a controller failure. In that case, a backup of the file needs to be copied onto a new (or repaired) disk. Recovering the file entails applying redo logs such that the state of the file is brought to the desired point in time. That point is usually as close to the time of failure as possible. In the database industry, these two operations are often referred to as *recovery*.

Oracle database can run in two modes: ARCHIVELOG mode or NOARCHIVELOG mode. In ARCHIVELOG mode, a used online redo log group must be copied to one or more archive destinations before it can be reused. Archiving the redo logs preserves all transactions stored in the logs, so that they can be used in recovery operations later. In NOARCHIVELOG mode, the online redo log groups are simply overwritten when the log is reused. All information about transactions recorded into that redo group is lost.

Running a database in NOARCHIVELOG mode imposes significant limitations on backup and recovery strategies. Backup operations cannot be performed on an online database in NOARCHIVELOG mode. The Oracle database must be shut down cleanly before taking a backup in NOARCHIVELOG mode. This method is often referred to as *offline backup* and is generally less desirable in the current, around-the-clock global environment. On the other hand, ARCHIVELOG mode (often referred to as *hot backup*) enables a more flexible backup and recovery strategy and is more suited for enterprise backup strategies.

2.2.1 Oracle Recovery Manager

Oracle Recovery Manager (RMAN) is a utility that performs backup and recovery activities of an Oracle database at block level. RMAN takes backups of database files, control files, spfile, and archived redo logs to either tape or disk. RMAN uses a catalog database to store RMAN repository information about one or more Oracle databases. RMAN uses this metadata to manage the backup, restore, and recovery of Oracle databases.

RMAN supports whole, full, and incremental backups.

Whole database backup: A whole database backup can be either backup sets or image copies of the entire set of data files and must include the control file. It can optionally include the server parameter file (SPFILE) and archived redo log files. Using RMAN to make an image copy of all the database files simply requires mounting or opening the database, starting RMAN, and entering a BACKUP command such as:

```
BACKUP DATABASE PLUS ARCHIVELOG DELETE INPUT;
```

The `DELETE INPUT` option can be given when backing up archive log files. It causes RMAN to remove the archive log files after backing them up. This is useful if a Fast Recovery Area is not in use to perform space management operations such as deleting files when space pressure grows.



Full Database Backup: A full data file backup is a backup that includes every used data block in the file. RMAN copies all the blocks into the backup set or image copy and skips only the data file blocks that have never been used. For a full image copy, the entire file contents are reproduced exactly. A full backup cannot be part of an incremental backup strategy; it cannot be the parent for a subsequent incremental backup.

Incremental Backups: An incremental backup is either a level 0 backup (including every block in the data files except blocks that have never been used), or a level 1 backup (including only those blocks that have been changed since a previous backup was taken). A level 0 incremental backup is physically identical to a full backup. The only difference is that the level 0 backup can be used as the base for a level 1 backup, but a full backup can never be used as the base for a level 1 backup. Incremental backups are specified using the INCREMENTAL keyword of the BACKUP command.

```
BACKUP INCREMENTAL LEVEL 0 DATABASE  
BACKUP INCREMENTAL LEVEL 1 DATABASE
```

Note: RMAN makes full backups by default if neither FULL nor INCREMENTAL is specified in the BACKUP command

RMAN activities are stored in the database control file. Optionally, a recovery catalog, which resides in a secondary database known as the catalog database, can be used to record RMAN activities against target databases. The use of a recovery catalog is recommended for an enterprise environment. Moreover, in a situation where all control file copies are lost, RMAN can recreate the control files from the information contained in the recovery catalog.

2.2.2 User managed backup

User Managed backups create exact copies of the physical files, including data files, control files, the password file, the parameter file, and the archived redo logs using operating system commands. These commands are often placed into scripts that can be scheduled to run at user-defined intervals.

Offline user managed backup is accomplished when the database is in a shutdown state, and provides a complete copy of the database that can be restored exactly. If the database is running in NOARCHIVELOG mode, this is the only possible backup mode.

Online user managed backup (often referred to as *hot backup*) can be done when the Oracle database is online and running in ARCHIVELOG mode. User defined hot backups typically take back up of data files, archived redo logs, and control files.

2.2.3 Storage Snapshot Backup

Snapshot backups are storage-based backups used to create an image of the database volumes, and can be reused by mounting the snapshot volumes onto a dedicated backup server or back onto the production database server itself. These snapshots are used to minimize the risk of data loss with increased backup frequency.

Primary methods of Oracle database backup and recovery solutions include:



Oracle RMAN full backup: Oracle RMAN is a utility for performing disk-to-tape or disk-to-disk backup and recovery of Oracle databases. RMAN is easy to use, and provides a wide range of flexible features for scheduling backup operations.

Oracle RMAN incremental backup: RMAN backup of data files can be full or incremental. A full backup consists of every used block of the data file. An incremental backup consists of only the data that changed since the previous incremental backup. The size of the incremental backups is usually smaller when compared to full backups.

User-managed backup: Instead of RMAN, operating system commands are used to copy the raw content of the database files.

Storage based backup using EqualLogic ASM/ME Smart Copy Snapshots: An EqualLogic Smart Copy snapshot preserves a copy of the contents of a volume at a point in time. In this case, the Oracle volumes are placed into an ASM/ME volume collection, the database is placed into hot backup mode, and a Smart Copy is taken of the entire volume collection to yield an application consistent snapshot. Administrators can use these Smart Copy snapshots to offload the backup operation to a different server, thereby reducing system resource usage on the production database servers. Snapshots are also very useful for preserving point-in-time copies of the production database.

Oracle FLASHBACK DATABASE: This feature eliminates the need to restore the database from tape or disk and provides a more efficient way for completing database point-in-time recovery.

Note: Oracle Flashback Database is a very powerful feature but a detailed discussion about it is beyond the scope of this paper. For more information about this topic and on Oracle backup and recovery in general, consult the [Oracle Database Backup and Recovery User's Guide](#) found on the Oracle Documentation Library.

2.3 Section summary

EqualLogic ASM/ME Smart Copies used in conjunction with Oracle RMAN can help improve the overall efficiency of backup and recovery operations. EqualLogic Smart Copies also provide the ability to offload the RMAN backup copy operation to a dedicated backup processing server. This helps to reduce the impact on precious production database server system resources during backup processing.

Note: While ASM/ME enhances and supplements your regular backup regimen by providing fast and efficient data recovery, it is not a replacement for a regular and complete backup of your data to long-term media. The use of third party backup software to transfer the data in Smart Copies to long-term backup media is recommended.



3 Performing Oracle database backup and recovery

The remainder of this paper focuses on demonstrating a methodology for performing Oracle database backup and recovery operations on Windows Server 2012 using Dell EqualLogic Smart Copy snapshots. The solutions presented are essentially a hybrid of various technologies and involve Oracle ODP.NET, RMAN, and EqualLogic Smart Copy Snapshots and EqualLogic PowerShell utilities. These technologies were discussed in the previous section.

3.1 Testing Environment

The testing environment used to develop the Oracle backup and recovery solutions demonstrated in this paper is shown in Figure 1.

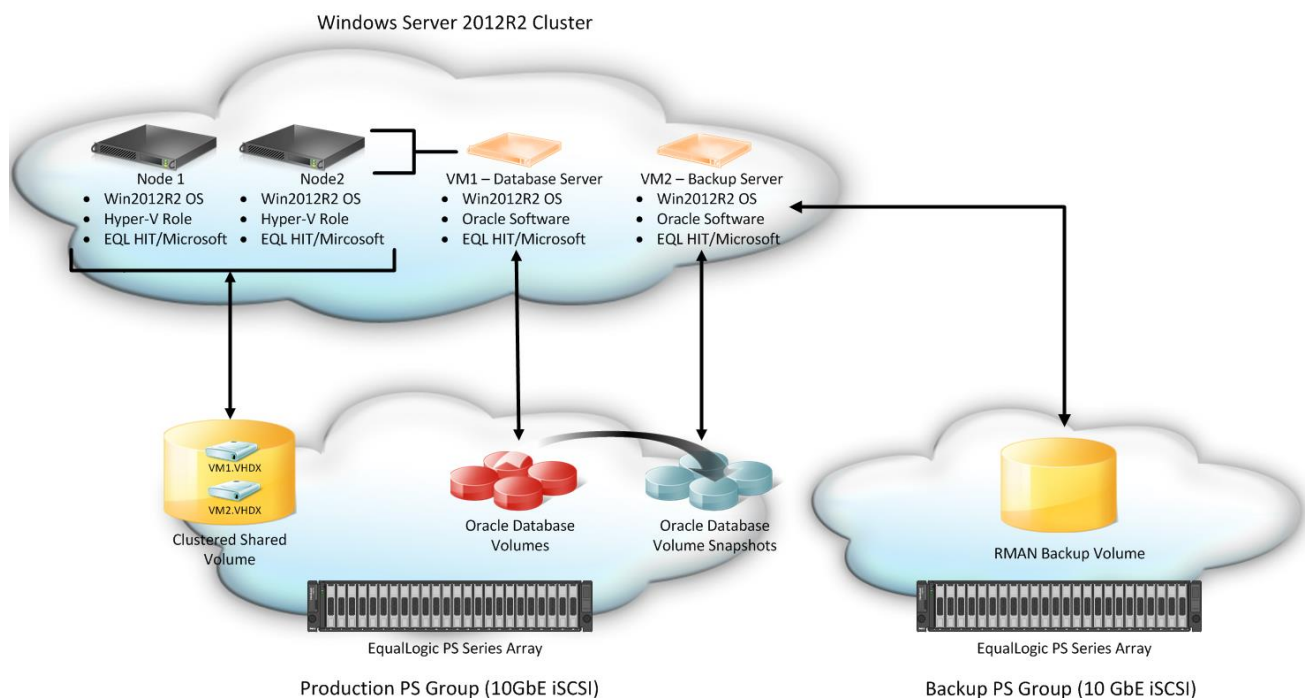


Figure 1 Oracle testing environment

Host/Guest VM environment: The server environment consists of a Windows Server 2012 R2 Hyper-V Cluster. The two primary roles installed on the Windows Server hosts are Hyper-V and Failover Cluster. Two Hyper-V guest virtual machines were created, one to act as the database server and the other to act as a dedicated backup server. The operating system for each guest virtual machine is Windows Server 2012 R2. Each guest has Oracle 11gR2 database software as well as the EqualLogic HIT/Microsoft V4.7 tools installed. HIT/Microsoft V4.7 has also been installed on each physical host of the Hyper-V cluster. No Oracle software is installed on either of the Hyper-V physical cluster hosts.

Network Configuration: All iSCSI connections to the hosts and guests are through an isolated 10 GbE network. All LAN connections to the hosts and guest utilize a 1 GbE network.

Storage: The primary storage in the configuration is a single member Dell EqualLogic PS6210X iSCSI array. The backup array is a Dell EqualLogic PS4110E iSCSI array.

Hyper-V guest database server volume layout: The following table details the Oracle database volume configuration. These volumes are provisioned directly to the iSCSI initiator of the Hyper-V database server guest from the EQL PS6210X:

Table 2 VM1 - Database Server, Oracle SID: ORCL

Volume	Files
DATA	Oracle Database Data Files
INDX	All Indexes
REDO1	Redo log files and control files
REDO2	Multiplexed redo log files and control files
ARCH1	Archive redo log destination 1
ARCH2	Archive redo log destination 2

Hyper-V guest backup server volume layout: The following table details the volumes provisioned directly to the iSCSI initiator of the Hyper-V Backup Server

Table 3 VM2 - Backup Server, Oracle SID: ORCL

Volume	Files
Snapshots from PS6210X Array	Snapshots of DATA, INDX, REDO1, REDO2, ARCH1 and ARCH2, volumes from database server.
FLASH	RMAN Backup Volume from PS4110E array

Hyper-V host cluster volume layout: The following table details the volumes which are provisioned directly to the iSCSI initiator of the Hyper-V hosts as clustered shared volumes:

Table 4 Hyper-V Host Cluster

Volume	Files
VMStorage	Clustered shared volume which houses VHDX and configuration files for database server and backup server Hyper-V guests



3.2 Prerequisites

The following conditions are prerequisites for the solutions demonstrated in this paper.

3.2.1 Software

The same versions of the Windows Operating System, Oracle Software, and EqualLogic HIT/Microsoft must be installed on the database server and the backup server. In the test environment for this paper, the following software was used:

- Windows Server 2012 R2
- Oracle Enterprise Database 11gR2
- EqualLogic HIT/Microsoft V4.7

Note: HIT/Microsoft V4.7 or greater is required as the ASM/ME PowerShell cmdlets used in this paper were introduced with this version.

3.2.2 iSCSI configuration

All EqualLogic best practices apply such as dedicated NICs and vNICs for iSCSI traffic on physical and virtual servers and enabling of Jumbo Frames. Also, ensure that the backup server has read/write access to the snapshots of the primary Oracle volumes. For more information on setting volume access type and access controls, see EqualLogic Group Manager User Guide and/or the online help from within Group Manager for more information at https://eglsupport.dell.com/support/download_file.aspx?id=2234.

Note: A support account is required to download this file.

3.2.3 ASM/ME HIT Group configuration

Ensure that the production database server and the backup server are part of the same HIT group in ASM/ME on the production and backup servers. This ensures that the backup server can access and mount the Smart Copies created for the Oracle database on the database server. For information on creating a HIT Group in ASM/ME, consult the ASM/ME User Guide documentation.

3.2.4 Oracle configuration on a dedicated backup server

Ensure that the Oracle software is installed using the same Oracle home directory structure on both the database and backup servers.

- On the backup server set the ORACLE_HOME and ORACLE_SID environment variables accordingly. See Step 1 of section 3.3.2 in this paper for instructions.
- Copy the database **init.ora** configuration and password **orapwd** files to the appropriate locations on the backup server. The **init.ora** file is usually found under the \$ORACLE_BASE \pfile directory and the password file can be found under \$ORACLE_HOME\BIN directory.
- Depending on the Oracle connection method used on the backup server, copy the **listener.ora** file and the **tnsnames.ora** from the \$ORACLE_HOME/Network directory database server to the



\$ORACLE_HOME/Network directory on the backup server. If needed, modify the **listener.ora** file to include the SID of the Oracle database under the SID_LIST_LISTENER section. An example of an entry for the Oracle database SID is "orcl" is shown below:

```
(SID_DESC =
  (GLOBAL_DBNAME = orcl)
  (ORACLE_HOME = c:\app\administrator\product\11.2.0\dbhome_1)
  (SID_NAME = orcl)
)
```

- If needed, modify the **tnsnames.ora** file to include the SID of the Oracle database and that the host parameter reflects the name of the backup server. An example of an entry with the SID of "orcl" and backup server name VM2.skynet.lab.local is shown below:

```
ORCL =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP) (HOST = VM2-ORABKPSERV.SKYNET.lab.local) (PORT =
1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = orcl)
    )
  )
```

For more information on configuring the Oracle listener process and naming methods, consult the [Oracle Database Net Services Administrator Guide](#) particularly [Chapter 8](#)

3.2.5 Oracle database run mode

The Oracle database must be running in **ARCHIVELOG** mode to create hot backups. To verify if the database is in ARCHIVELOG mode, open a sqlplus connection to the database run the following command: **archive log list;**

```
SQL> archive log list;
Database log mode                Archive Mode
...
```

If the database is in ARCHIVELOG mode, the value for Database log mode in the output will be **Archive Mode**. If the database is not in ARCHIVELOG mode, the value will be **No Archive Mode**. For instructions on how to place the database in ARCHIVELOG mode, consult the Oracle documentation library at: http://docs.oracle.com/cd/B28359_01/server.111/b28310/archredo003.htm#ADMIN11333



3.2.6 Oracle database volume collections in EqualLogic ASM/ME (consistency Groups)

An ASM/ME collection of the volumes used by the Oracle database is required for the creation of application consistent Smart Copies. ASM/ME collections enable consistency across a group of volumes in a single Smart Copy. Create two collections for the Oracle database application.

- Create one collection that contains all of the volumes used by the database. In the example, this includes volumes DATA, INDX, REDO1, REDO2, ARCH1, and ARCH2. This collection could be used for a point-in-time database recovery.
- Create another collection that includes only the DATA and INDX volumes. This collection could be used for a complete database recovery scenario for zero data loss in which RMAN would be used to perform a roll forward recovery.

A collection is easily be created in ASM/ME or using the following EQL ASM PowerShell command:

```
[VM1-ORACLEDBSER] PS C:\>New-ASMCollection -collectionname orclvols -Volume  
E:\,F:\,G:\,H:\,I:\,J:\ -IsVolumeBased:$true
```

The new collection named orclvols will consist of volumes E:\, F:\ ... to represent the corresponding drive letters for the mounted Oracle database volumes on the database server (such as DATA, INDX, and REDO1).

For information on creating collections using ASM/ME, consult the *ASM/ME User Guide* found in the EqualLogic HIT/Microsoft installation directory at c:\program files\equallogic\doc or download the guide at: https://eqsupport.dell.com/support/download_file.aspx?id=2484.

3.3 Use Cases

The Oracle backup and recovery solutions discussed in this section are:

- Creating an application consistent snapshot of a running Oracle database on Windows Server

In this case, an application consistent Oracle database snapshot is taken using EqualLogic Smart Copy technology, Oracle's ODP.NET, and HIT/Microsoft PowerShell tools.

- Mounting an EqualLogic Smart Copy Snapshot to a dedicated Oracle backup server for RMAN backup offload

In this case, the application consistent Oracle Snapshot is mounted on a dedicated backup server to offload RMAN backup operations. Optionally, the same procedure could be used for test and development.

- Using an EqualLogic Smart Copy snapshot for point-in-time database recovery

In this case, a database is restored to a specific point in time from a Smart Copy snapshot. The snapshot is of a collection that contains all of the volumes comprising the Oracle database. The



database is brought down; its volumes restored from the collection snapshot; restarted; and then crash recovered. This brings the database to the last redo commit and to the point in time of the snapshot.

- Using an EqualLogic Smart Copy snapshot for complete database recovery with zero data loss

In this case, a Smart Copy snapshot of only the Oracle database data and index files is used to recover lost data. First, the data and index files are restored from the snapshot. Then, the archived logs and online redo logs are applied to perform a roll forward recovery that yields zero data loss

3.3.1 Application consistent snapshot of an Oracle database on Windows Server

This section details how to create an application consistent EqualLogic Smart Copy snapshot of a running Oracle database. It uses Oracle ODP.NET to open the connection to the database and run SQL commands against the data and the EqualLogic HIT/Microsoft PowerShell tool set to create the Smart Copy. The methods provided in this section form the basis of a PowerShell script to place in the Windows scheduler utility on the Oracle database server for automated Smart Copy creation. All of the following commands are run from PowerShell on the database server. A sample PowerShell script which uses this methodology can be found in Appendix A, "Sample PowerShell script".

Step 1: Import the required EqualLogic PS and ASM Microsoft PowerShell tool modules.

```
[VM1-ORACLEDBSER] PS C:\>Import-Module -Name "c:\program
files\equallogic\bin\EqlASMPSTools.dll"
[VM1-ORACLEDBSER] PS C:\>Import-Module -Name "c:\program
files\equallogic\bin\EqlPSTools.dll"
```

Step 2: Load the Oracle ODP.NET dll.

The ODP.NET dll (Oracle.DataAccess.dll) can be found in the \$ORACLE_HOME/ODP.NET/bin/2.x directory. Detailed Information on ODP.NET can be found on Oracle Technetwork at:

<http://www.oracle.com/technetwork/topics/dotnet/index-085163.htm>

Note: For information at using ODP.NET from within PowerShell go to "Scripting Guys Blog" at: <http://blogs.technet.com/b/heyscriptingguy/archive/2012/12/04/use-oracle-odp-net-and-powershell-to-simplify-data-access.aspx>
...and at: <http://guyharrison.typepad.com/yadb/2008/01/accessing-oracle.html>

```
[VM1-ORACLEDBSER] PS C:\>
[reflection.assembly]::LoadFile("c:\app\administrator\product\11.2.0\dbhome_1\ODP.NET\bin
\2.x\Oracle.DataAccess.dll")
```



Step 3: Create a connection string that includes the database user, password, and TNS service name for the database (found in the tnsnames.ora file). Then use the string to create a new connection object from where the ODP.NET connect method can be executed. Once the connection object is created successfully, the open method opens the connection to the database.

```
[VM1-ORACLEDBSER] PS C:\>$constr = "User Id=System;Password=tiger;Data Source=orcl"
[VM1-ORACLEDBSER] PS C:\>$con= New-Object
    Oracle.DataAccess.Client.OracleConnection($constr)
[VM1-ORACLEDBSER] PS C:\> $con.open()
```

Verify that the connection to the database was successfully made by displaying the database name, host name, service name, and Oracle software version.

```
[VM1-ORACLEDBSER] PS C:\> "Connected to database: {0} running on host: {1} - Servicename:
    {2} - Serverversion: {3}" -f $con.DatabaseName, $con.HostName, $con.ServiceName,
    $con.ServerVersion
<output>
Connected to database: orcl running on host: vm1-oracledbser - Servicename: orcl -
    Serverversion: 11.2.0.1.0
```

Step 4: Place the Oracle database into hot backup mode.

Note: As mentioned earlier, the Oracle database must be running in ARCHIVELOG mode in order to be placed in hot backup.

This step places the database into hot backup by issuing a SQL command with the open database connection. First, create a command object using the **alter database begin backup** SQL command through the open database connection of \$con.

```
[VM1-ORACLEDBSER] PS C:\>$hotbackupcmd = new-Object
    Oracle.DataAccess.Client.OracleCommand("alter database begin backup",$con)
```

Execute the hot backup command object by calling the executereader method on the hotbackupcmd object.

```
[VM1-ORACLEDBSER] PS C:\>$hotbackupcmd.ExecuteReader()
```

Optional: To verify that the hot backup command was successful, perform the PowerShell equivalent of the UNIX tail -f command on the Oracle trace log and watch the output.

```
[VM1-ORACLEDBSER] PS C:\>Get-content
    "C:\app\Administrator\diag\rdbms\orcl\orcl\trace>alert_orcl.log" -tail 10 -wait
<screen output from file...>
alter database begin backup
Completed: alter database begin backup
```



Step 5: As a best practice, close the connection to the Oracle database once the database is in hot backup. This connection can be re-opened after the snapshot is created.

```
[VM1-ORACLEDBSER] PS C:\>$con.close()
```

Step 6: Create a Smart Copy Snapshot of the Oracle volume collection with EQLASMPSTools.

In this example, the volume collection is called **orclvols** and is comprised of all of the volumes used by the database. The command to create the Smart Copy is **New-ASMSmartCopy**.

```
[VM1-ORACLEDBSER] PS C:\>New-ASMSmartCopy -ObjectName "collection{orclvols}" -
    SmartCopyType snapshot -scheduleID "orcl_hourly_snapshot" -keepcount 24 -ErrorAction
    stop
<command output...>
Creating Smart Copy set for Collection{orclvols}...

SmartCopyName      : orclvols (6/26/2014 4:55:06 PM)
SmartCopyType      : Snapshot
Created            : 6/26/2014 4:55:06 PM
OriginatingComputer : VM1-OracleDBServ.SKYNET.lab.local
OriginalObjectName : orclvols
isAccessible       : True
ObjectName         : SnapshotSet{49741394-0a13-4c08-acb6-90f13f310554}
OriginalObjectId   : Collection{orclvols}
```

Note: the **keepcount** flag tells ASM/ME that a maximum of 24 Smart Copies for the particular object (in this case the orclvols collection) are to be kept before the oldest Smart Copy is to be deleted. See the *EqualLogic PowerShell Tools Reference Guide* for more information on this flag.

Optional: To get a list of all the Smart Copies for a particular ASM object use the **get-ASMSmartCopy** command. In the example, the collection "Collection{orclvols}" is used as the search string for the **originalobjectid** and the output is formatted to show only the **SmartCopyName**, **ObjectName**, and the **OriginalObjectID**.

```
[VM1-ORACLEDBSER] PS C:\>get-asmsmartcopy | ? {$_.originalobjectid -like "*orclvols"} |
ft -Property SmartCopyName,ObjectName,OriginalObjectID -AutoSize
```

SmartCopyName	ObjectName
OriginalObjectID	
-----	-----
orclvols (6/5/2014 10:58:24 AM)	SnapshotSet{3e95d555-c6c5-402e-b001-492cdfb8d4b3}
Collection{orclvols}	
orclvols (6/24/2014 2:25:46 PM)	SnapshotSet{5106ac10-b6d2-4d6a-a086-b2b3f7e5a1f8}
Collection{orclvols}	
orclvols (6/26/2014 4:55:06 PM)	SnapshotSet{49741394-0a13-4c08-acb6-90f13f310554}
Collection{orclvols}	



Step 7: If closed, reopen the connection to the database.

Reconnect to the database using the existing database connection object created in step 3 (\$con).

```
[VM1-ORACLEDBSER] PS C:\>$con.Open()
```

Step 8: Take the database out of hot backup mode by issuing the alter database end backup" SQL command. Use the same methodology used in step 4 to place the database into hot backup mode.

```
[VM1-ORACLEDBSER] PS C:\>$sendbackupcmd = new-Object  
Oracle.DataAccess.Client.OracleCommand("alter database end backup",$con)
```

```
[VM1-ORACLEDBSER] PS C:\>$sendbackupcmd.ExecuteReader()
```

Optional: Verify that the end backup command was successful by watching the Oracle trace log.

```
[VM1-ORACLEDBSER] PS C:\>Get-content  
"C:\app\Administrator\diag\rdbms\orcl\orcl\trace>alert_orcl.log" -tail 10 -wait
```

<screen output from file...>

```
alter database end backup  
Completed: alter database end backup
```

Step 9: Once the database is out of hot backup mode, archive the current redo log by issuing the **alter system archive log current** SQL command.

```
[VM1-ORACLEDBSER] PS C:\>$archiveredologcmd = new-Object  
Oracle.DataAccess.Client.OracleCommand("alter system archive log current",$con)
```

```
[VM1-ORACLEDBSER] PS C:\>$archiveredologcmd.ExecuteReader()
```

Optional: Verify that the current redo log was successfully archived by watching the output in the Oracle trace log.

```
[VM1-ORACLEDBSER] PS C:\>Get-content  
"C:\app\Administrator\diag\rdbms\orcl\orcl\trace>alert_orcl.log" -tail 10 -wait
```

<screen output from file...>

```
ALTER SYSTEM ARCHIVE LOG  
Mon Jun 30 10:08:58 2014  
Thread 1 advanced to log sequence 150 (LGWR switch)  
Current log# 3 seq# 150 mem# 0:  
H:\APP\ADMINISTRATOR\ORADATA\ORCL\ONLINELOG\O1_MF_3_9RZ0WS78_.LOG  
Current log# 3 seq# 150 mem# 1:  
I:\APP\ADMINISTRATOR\ORADATA\ORCL\ONLINELOG\O1_MF_3_9RZ0WSBP_.LOG  
Archived Log entry 293 added for thread 1 sequence 149 ID 0x52157356 dest 1:  
Archived Log entry 294 added for thread 1 sequence 149 ID 0x52157356 dest 2:
```



Step 10: Once the redo log has been archived, close the connection to the Oracle database.

```
[VM1-ORACLEDBSER] PS C:\>$con.close()
```

Step 11: Use Windows Task Scheduler utility to schedule the Oracle snapshot PowerShell script to run at specific times during the day.

Steps 1 -10 provide the commands that can be used to create a simple PowerShell script that creates an application consistent snapshot of a running Oracle database. Windows Task Scheduler utility uses script can to run at desired times determined by the backup and recovery strategy. The following command line shows how to use the schtasks utility to create a repeating task. In the example, the name of the task designated by the /tn parameter is "Orcl Snapshot Script". The /tr parameter specifies the task to run (in this case, the created backup being called by the PowerShell executable). The /sc parameter specifies that the script should run hourly, and the /st parameter specifies that the script should run at quarter past the hour.

```
[VM1-ORACLEDBSER] PS C:\>schtasks /create /tn "Orcl Snapshot Script" /tr "powershell.exe  
-file C:\scripts\Oracle_ODP_Snapshot_Script_v1.5.ps1" /sc hourly /st 00:15
```

For more information about scheduling tasks in Windows server with the schtasks utility, go to http://technet.microsoft.com/en-us/library/cc725744.aspx#BKMK_minutes



3.3.2 Mounting the EqualLogic ASM Smart Copy snapshot

One of the more common use cases of storage based snapshots in Oracle backup and recovery is mounting the snapshot on a dedicated backup server that performs RMAN backup operations. A known drawback of performing RMAN operations on a production database server is that it places increased load on the production database server CPU and memory resources while running the backup operations. In this use case, the RMAN backups from the production database are offloaded to a dedicated backup server to improve the production database performance and to shrink backup windows. This will be accomplished by mounting an existing EqualLogic Smart Copy Snapshot of the Oracle database volume collection. The volume collection contains all of the volumes that comprise the Oracle database.

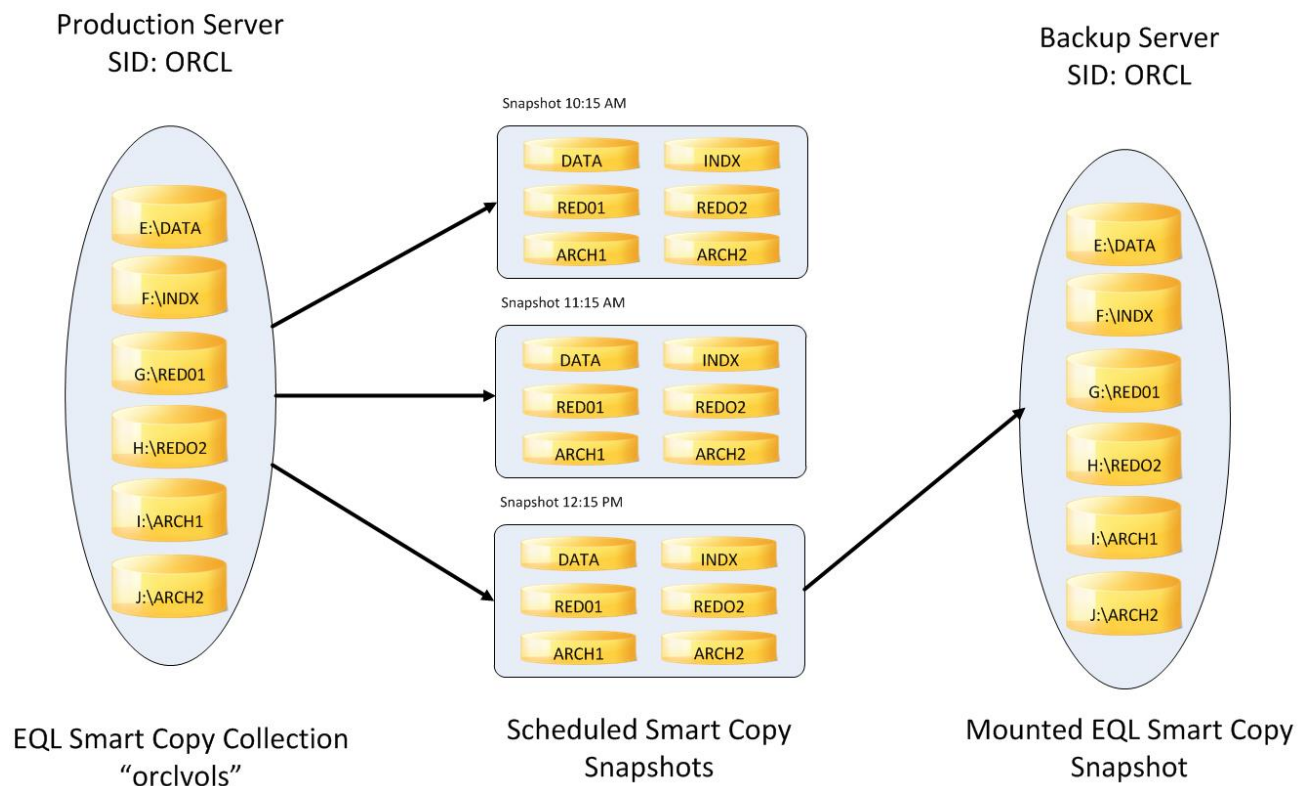


Figure 2 Mounted snapshot of the collection on a backup server

The following procedure demonstrates how to mount an EqualLogic Smart Copy snapshot of an Oracle database onto a dedicated backup server for RMAN backup operations. As in the previous sections, the steps shown in this section could be used to form PowerShell scripts.

Step 1: Review the Oracle configuration requirements for the backup server covered in section 0 and ensure that the environment is configured properly.

To examine the environment variables on the backup server using PowerShell, use the following command:

```
[VM2-ORABKPSERV] PS C:\> get-childitem ENV:

<command output...>
...
ProgramData                C:\ProgramData
ProgramFiles               C:\Program Files
ProgramFiles(x86)         C:\Program Files (x86)
ProgramW6432              C:\Program Files
PSModulePath              C:\Users\Administrator\Documents\WindowsPowerShell\Modules
PUBLIC                    C:\Users\Public
SESSIONNAME               RDP-Tcp#1
SystemDrive               C:
SystemRoot                C:\Windows
TEMP                     C:\Users\ADMINI~1\AppData\Local\Temp\2
TMP                      C:\Users\ADMINI~1\AppData\Local\Temp\2
USERDOMAIN                VM2-2012R2
USERDOMAIN_ROAMINGPROFILE VM2-2012R2
USERNAME                  Administrator
USERPROFILE              C:\Users\Administrator
windir                   C:\Windows
```

To set the ORACLE_SID and ORACLE_HOME environment variable use the following PowerShell commands. The Oracle SID used in the example is orcl.

```
[VM2-ORABKPSERV] PS C:\> $env:ORACLE_HOME="c:\app\administrator\product\11.2.0\dbhome_1"
[VM2-ORABKPSERV] PS C:\> $env:ORACLE_SID="orcl"
```

To verify that the new environment variables were set successfully, use the following command for ORACLE_HOME and ORACLE_SID.

```
[VM2-ORABKPSERV] PS C:\> (get-childitem ENV:ORACLE_HOME).value
c:\app\administrator\product\11.2.0\dbhome_1
```

Finally, ensure that the Oracle listener process can be started on the backup server. Verify that the listener can find the name of the database listener service and create a handle for the Oracle SID (orcl) specified in listener.ora file.

```
[VM2-ORABKPSERV] PS C:\> lsnrctl start
<Command output...>
LSNRCTL for 64-bit Windows: Version 11.2.0.1.0 - Production on 11-JUN-2014 14:21:30
Copyright (c) 1991, 2010, Oracle. All rights reserved.
Starting tnslnr: please wait...
TNSLSNR for 64-bit Windows: Version 11.2.0.1.0 - Production
System parameter file is
  c:\app\administrator\product\11.2.0\dbhome_1\network\admin\listener.ora
```



```

Log messages written to c:\app\administrator\diag\tnslsnr\VM2-
ORABKPSERV\listener\alert\log.xml
Listening on: (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp) (HOST=VM2-
ORABKPSERV.SKYNET.lab.local) (PORT=1521)))
Listening on: (DESCRIPTION=(ADDRESS=(PROTOCOL=ipc) (PIPENAME=\\.\pipe\EXTPROC1521ipc)))
Connecting to (DESCRIPTION=(ADDRESS=(PROTOCOL=TCP) (HOST=VM2-
ORABKPSERV.SKYNET.lab.local) (PORT=1521)))
STATUS of the LISTENER
-----
Alias                               LISTENER
Version                             TNSLSNR for 64-bit Windows: Version 11.2.0.1.0 - Production
Start Date                           11-JUN-2014 14:21:36
Uptime                               0 days 0 hr. 0 min. 5 sec
Trace Level                           off
Security                             ON: Local OS Authentication
SNMP                                 OFF
Listener Parameter File
c:\app\administrator\product\11.2.0\dbhome_1\network\admin\listener.ora
Listener Log File                    c:\app\administrator\diag\tnslsnr\VM2-
ORABKPSERV\listener\alert\log.xml
Listening Endpoints Summary...
  (DESCRIPTION=(ADDRESS=(PROTOCOL=tcp) (HOST=VM2-ORABKPSERV.SKYNET.lab.local) (PORT=1521)))
  (DESCRIPTION=(ADDRESS=(PROTOCOL=ipc) (PIPENAME=\\.\pipe\EXTPROC1521ipc)))
Services Summary...
Service "CLRExtProc" has 1 instance(s).
  Instance "CLRExtProc", status UNKNOWN, has 1 handler(s) for this service...
Service "orcl" has 1 instance(s).
  Instance "orcl", status UNKNOWN, has 1 handler(s) for this service...
The command completed successfully

```

The output shows that a single handler was created for the database instance orcl. The instance status is unknown at this point because it has not yet been created.

Troubleshooting tip: If the listener process does not start up properly and/or the database instance handler is not present, then chances are the backup server is misconfigured. Check the entries in the copied tnsnames.ora and listener.ora files and verify that the prerequisites specified in Section 0 are met.

Step 2: Examine the available Smart Copies for the collection that contains the Oracle database volumes.

In a production environment, the Oracle database most likely has snapshots taken at least once an hour depending upon the snapshot schedule. Therefore, it is important to identify the appropriate Smart Copy to mount on the backup server. This can be done using EQL ASM PowerShell commands

As before, ensure to import the EqualLogic PS and ASM PowerShell tool modules before running the commands

```

[VM1-ORACLEDBSER] PS C:\>Import-Module -Name "c:\program
files\equallogic\bin\EqlASMPSTools.dll"

```



```
[VM1-ORACLEDBSER] PS C:\>Import-Module -Name "c:\program
files\equallogic\bin\EqlPSTools.dll"
```

Once the modules are imported, use the following get-ASMSmartCopy command to find the Smart Copies associated with the orclvols collection.

```
[VM2-ORABKPSERV] PS C:\> Get-ASMSmartCopy | ? {$_.OriginalObjectId -eq
"Collection{orclvols}" } | ft -property OriginalObjectId,Created,ObjectName -AutoSize
```

OriginalObjectId	Created	ObjectName
Collection{orclvols}	6/5/2014 12:15:24 PM	SnapshotSet{3e95d555-c6c5-402e-b001-492cdfb8d4b3}
Collection{orclvols}	6/5/2014 11:15:12 AM	SnapshotSet{52123b77-291f-4bde-acde-e90abd7fe7be}
Collection{orclvols}	6/9/2014 10:15:49 AM	SnapshotSet{efa808f5-4c9f-49dc-925d-06765565ed1d}

Step 3: Mount the selected EqualLogic Smart Copy snapshot to the backup server.

The EQL ASM PowerShell tools can be used to mount the Smart Copy snapshot of a collection onto the backup server. Depending on the backup type and backup schedule, an individual smart copy can be mounted onto the backup server using the following command:

```
[VM2-ORABKPSERV] PS C:\> Mount-ASMSmartCopy -ObjectName "SnapshotSet{3e95d555-c6c5-402e-
b001-492cdfb8d4b3}" -ReadWrite -location "**"
```

<Command Output>

Waiting for the agent...

Starting operation...

Mounting Smart Copy set \\10.124.4.78\teamshare\ProgramData\EqualLogic\VSS

Requestor\Shadows\Collection{orclvols}\efa808

f5-4c9f-49dc-925d-06765565ed1d.pvss...

Mounting Smart Copy of I:\ at I:\

Mounting Smart Copy of J:\ at J:\

Mounting Smart Copy of K:\ at K:\

Mounting Smart Copy of H:\ at H:\

Mounting Smart Copy of E:\ at E:\

Mounting Smart Copy of F:\ at F:\

Mounting Smart Copy of G:\ at G:\

ASM PowerShell tried to mount 7 Smart Copies:

Volumes mounted successfully:

E:\;

F:\;

G:\;

H:\;

I:\;

J:\;

K:\;



The above command specifies the latest snapshot (from 12:15 PM) in the `-objectname` parameter and it is mounted to the backup server. When specifying the `"*"` for the location parameter, the command will attempt to replicate the drive letter structure for the mounted snapshot to match that of parent collection. If it cannot do this, it will use the next available drive letter.

Note: When mounting the snapshot, it is important to ensure that the mounted snapshot volumes have the same corresponding drive letters as the production volumes on the database server. Otherwise, it is unlikely that the mounted database will not be able to be brought up on the backup server without manually modifying the copied `init.ora` file. Also, always mount the smart copy as read write on the backup server.

Scripting Tip: Instead of specifying a specific Smart Copy in the `-objectname` parameter, an alternative technique would be to use the `-UseLatest` flag with the `mount-ASMSmartCopy` command to mount the latest available Smart Copy of for the volume collection. This might be a more desirable technique to pick a smart copy for a scheduled backup and recovery script. The benefit of this method is a guarantee that the latest smart copy is used every time the script runs. It also eliminates the need for specifying a specific Smart Copy in the script. The use of the `-UseLatest` flag is shown in the following command:

```
[VM2-ORABKPSERV] PS C:\> Mount-ASMSmartCopy -ObjectName "Collection{orclvols}" -
ReadWrite
-UseLatest -location "*"
Notice that the collection name is specified in the -objectname parameter.
```

Step 4: After the listener process has been started and a handler has been created, start up the Oracle instance service for the `"orcl"` SID on the backup server using the following command:

```
[VM2-ORABKPSERV] PS C:\> oradim -new -SID orcl
Instance created.
```

The Oracle `oradim` utility is a command-prompt tool that creates, deletes, stops, and starts oracle instances on Windows. The ORADIM utility only exists for Oracle deployments on Windows because the `dbstart` and `dbstop` shell scripts do not exist for Windows platforms.

To verify that the Oracle instance service was started successfully run the following `get-service` command and look for the `OracleService<SID>` service and verify that it is running:

```
[VM2-ORABKPSERV] PS C:\> get-service | ? {$_.name -like "OracleService*"}
```

Status	Name	DisplayName
-----	----	-----
Running	OracleServiceorcl	OracleServiceorcl



Step 5: Use RMAN to connect, recover, and backup the mounted snapshot database.

Note: The following section is a demonstration of some basic RMAN commands such as connecting to an Oracle database instance; performing a database recovery; setting some RMAN configuration parameters; and performing an incremental backup of the mounted EQL Smart Copy snapshot database. For detailed information on how to use RMAN, please consult the [Oracle Database Backup and Recovery User's Guide](#) found on the Oracle Documentation Library.

Once the snapshot of the production database has been mounted and its database instance service has been started, the RMAN utility can be invoked on the backup server to connect to the instance, start the database from the snapshot, and then recover the database by replaying the logs and taking it out of hot backup mode.

1. The first step is to connect to the idle Oracle instance by starting RMAN and connect with the "sys" user credentials shown below.

```
[VM2-ORABKPSERV] PS C:\> RMAN Target /
```

<Command output>

```
[VM2-2012R2] PS C:\Users\Administrator>rman target /
Recovery Manager: Release 11.2.0.1.0 - Production on Mon Jul 14 11:04:33 2014
Copyright (c) 1982, 2009, Oracle and/or its affiliates. All rights reserved.
connected to target database (not started)
```

```
RMAN>
```

Upon connecting, a message will be returned that the Oracle database is not started. This is normal as the instance service has started but not the actual database itself.

Troubleshooting Tips:

- The above connection string "RMAN Target /" works as long as the prerequisites in section 3.2.4 have been met. If this method fails double check the prerequisites or consult the [Oracle Database Net Services Administrator Guide](#).
- Launching SQLPlus on Windows Server is best performed from a PowerShell session with administrator rights or from the command line. Attempting to launch SQLPlus from the PowerShell ISE could result in shell permission conflicts which require further troubleshooting.

2. Once connected to the instance, the Oracle database can be started on the backup server by specifying the copied init.ora file to use as a configuration. If the mount points of the snapshot volumes match the mount points from the database server, the database should start with no issue. To start the database, use the startup command specifying not to mount the database and specify the pfile parameter entering the full path to the copied init.ora file on the backup server.

```
RMAN> startup nomount
pfile="c:\app\administrator\admin\orcl\pfile\init.ora.542014163944"
```



```
<command output>
ORACLE instance started.
```

```
Total System Global Area 3340451840 bytes
Fixed Size                  2180344 bytes
Variable Size               1811942152 bytes
Database Buffers            1509949440 bytes
Redo Buffers                 16379904 bytes
```

```
RMAN>
```

3. Mount the Oracle database.

Once the Oracle database is started, mount it with the **alter database mount** SQL command from within RMAN. If the database is mounted successfully, the return message will be "Database altered".

```
RMAN> alter database mount;
Database altered.
RMAN>
```

4. Recover the mounted Oracle database.

Recover the mounted snapshot database using the **recover database** command. This is often necessary to do as the RMAN **recover database** command will replay the archived and online redo logs and bring the database to the desired SCN. It will also take the restored snapshot database out of hot backup mode.

```
RMAN> recover database;

Starting recover at 14-JUL-14
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=134 device type=DISK

starting media recovery
media recovery complete, elapsed time: 00:00:01

Finished recover at 14-JUL-14
```

5. Examine RMAN backup configuration parameters

Examine the RMAN configuration parameters with the **show all** command.

```
RMAN> show all;
```

```
<command output>
```

```
using target database control file instead of recovery catalog
RMAN configuration parameters for database with db_unique_name ORCL are:
```

```
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default
CONFIGURE BACKUP OPTIMIZATION OFF; # default
```



```

CONFIGURE DEFAULT DEVICE TYPE TO DISK; # default
CONFIGURE CONTROLFILE AUTOBACKUP OFF; # default
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO '%F'; # default
CONFIGURE DEVICE TYPE DISK PARALLELISM 1 BACKUP TYPE TO BACKUPSET; # default
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE MAXSETSIZE TO UNLIMITED; # default
CONFIGURE ENCRYPTION FOR DATABASE OFF; # default
CONFIGURE ENCRYPTION ALGORITHM 'AES128'; # default
CONFIGURE COMPRESSION ALGORITHM 'BASIC' AS OF RELEASE 'DEFAULT' OPTIMIZE FOR LOAD
TRUE ; # default
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE; # default
CONFIGURE SNAPSHOT CONTROLFILE NAME TO
'C:\APP\ADMINISTRATOR\PRODUCT\11.2.0\DBHOME_1\DATABASE\SNCFORCL.ORA'; # default

```

6. Optional: Change RMAN backup location and backup retention period.

In this example, the backup server guest used an EQL direct attach iSCSI volume mounted with the drive letter "Y" and the directory path "Y:\backup\RMAN". A typical RMAN retention policy is between 20 – 30 days; however, this can vary greatly depending on individual customer backup requirements, schedules, and storage resources.

The following RMAN commands can be used to set the backup location and naming format.

```
RMAN> configure channel device type disk format 'Y:\backup\rman\full_%u_%s_%p';
```

<command output>

```

new RMAN configuration parameters:
CONFIGURE CHANNEL DEVICE TYPE DISK FORMAT      'Y:\backup\rman\full_%u_%s_%p';
new RMAN configuration parameters are successfully stored
...and backup retention policy to 21 days.
RMAN> configure retention policy to recovery window of 21 days;

```

<command output>

```

new RMAN configuration parameters:
CONFIGURE RETENTION POLICY TO RECOVERY WINDOW OF 21 DAYS;
new RMAN configuration parameters are successfully stored

```

7. Perform an incremental level 1 backup of the Oracle database using the following command (the tag parameter allows for custom naming of the backup for easier identification).

```
RMAN> backup incremental level 1 database tag 'ORCL_DB_Hourly';
```

<command output>

```

Starting backup at 14-JUL-14
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=23 device type=DISK
no parent backup or copy of datafile 2 found
no parent backup or copy of datafile 3 found
no parent backup or copy of datafile 1 found
no parent backup or copy of datafile 5 found

```



```

no parent backup or copy of datafile 4 found
channel ORA_DISK_1: starting incremental level 0 datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00002
name=E:\APP\ADMINISTRATOR\ORADATA\ORCL\DATAFILE\O1_MF_SYSAUX_9RZ0T7JH_.DBF
input datafile file number=00003
name=E:\APP\ADMINISTRATOR\ORADATA\ORCL\DATAFILE\O1_MF_UNDOTBS1_9RZ0T7JH_.DBF
input datafile file number=00001
name=E:\APP\ADMINISTRATOR\ORADATA\ORCL\DATAFILE\O1_MF_SYSTEM_9RZ0T7H0_.DBF
input datafile file number=00005
name=E:\APP\ADMINISTRATOR\ORADATA\ORCL\DATAFILE\O1_MF_EXAMPLE_9RZ0WYSC_.DBF
input datafile file number=00004
name=E:\APP\ADMINISTRATOR\ORADATA\ORCL\DATAFILE\O1_MF_USERS_9RZ0T7KH_.DBF
channel ORA_DISK_1: starting piece 1 at 14-JUL-14
channel ORA_DISK_1: finished piece 1 at 14-JUL-14
piece handle=Y:\BACKUP\RMAN\FULL_01PDC4K8_1_1 tag=ORCL_DB_Hourly comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:45
channel ORA_DISK_1: starting incremental level 1 datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
including current control file in backup set
channel ORA_DISK_1: starting piece 1 at 14-JUL-14
channel ORA_DISK_1: finished piece 1 at 14-JUL-14
piece handle=Y:\BACKUP\RMAN\FULL_02PDC4LM_2_1 tag=ORCL_DB_Hourly comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 14-JUL-14

```

This backup command starts a cumulative level 1 incremental backup for the database. By specifying a level 1 backup, RMAN checks to see if a previous level 0 backup for the database exists. If the level 0 does not exist, the specified level 1 backup will default to a level 0. All following on backups will be level 1 incremental.

8. Once the backup is complete, examine the backup list by using the RMAN "list backup summary" command

```
RMAN> list backup summary;
```

<command output>

List of Backups

=====

Key	TY	LV	S	Device	Type	Completion Time	#Pieces	#Copies	Compressed	Tag
1	B	0	A	DISK		14-JUL-14	1	1	NO	ORCL_DB_HOURLY
2	B	1	A	DISK		14-JUL-14	1	1	NO	ORCL_DB_HOURLY

9. After the RMAN backup operations are complete, shut down the Oracle database, stop the Oracle Instance service, and dismount the Smart Copy snapshot from the backup server.

```
RMAN> shutdown immediate;
```

Database closed.



```
Database dismounted.  
ORACLE instance shut down.
```

```
RMAN> exit
```

```
Recover Manager complete.
```

```
[VM2-ORABKPSERV] PS C:\>  
Optional - Stop the Oracle instance service on the backup server:  
[VM2-ORABKPSERV] PS C:\> stop-service OracleServiceOrc1  
Verify that the service stopped successfully.  
[VM2-ORABKPSERV] PS C:\> get-service OracleServiceOrc1
```

Status	Name	DisplayName
Stopped	OracleServiceOrc1	OracleServiceOrc1

Step 6: Dismount the Smart Copy Snapshot from the backup server

Dismount the EQL Smart Copy Snapshot from the backup server using the following EQL ASM PowerShell one-line command.

```
[VM2-ORABKPSERV] PS C:\> Get-ASMSmartCopy -ObjectName "collection{orclvols}" -Full |  
? {$_.ismounted -eq $true} | Dismount-ASMSmartCopy
```

```
<command output>  
Waiting for the agent...  
Starting operation...  
Unmounting Smart Copy set \\10.124.4.78\teamshare\ProgramData\EqualLogic\VSS  
Requestor\Shadows\Collection{orclvols}\4db3f811-5273-48a3-9272-0175049c1149.pvss...  
All volumes unmounted successfully for Smart Copy set:  
\\10.124.4.78\teamshare\ProgramData\EqualLogic\VSS  
Requestor\Shadows\Collection{orclvols}\4db3f811-5273-48a3-9272-0  
175049c1149.pvss
```

This get-ASMSmartCopy command searches for the mounted Smart Copy of the volume collection "orclvols" by searching the "ismounted" property. Once it finds the mounted Smart Copy, it passes it as an object into the Dismount-ASMSmartCopy command, dismounting it from the backup server.

In creating a script to dismount the smart copy, it would be tempting to use the -Uselastest flag as was done with the mount-ASMSmartCopy command in the scripting tip notes of Step 2. However, in production environments, Smart Copy snapshots might be created at a faster interval than the time it takes to finish the RMAN operations - thereby resulting with the latest Smart Copy of the collection not being the one mounted to the backup server when the dismount command is called in a script. This situation would result in an error. The most accurate way to determine the mounted Smart Copy snapshot of the collection is to use the above one-line command.



3.3.3 Oracle database point-in-time restore with EqualLogic Smart Copy

The main objective of a point-in-time recovery is to quickly restore a database to a specific point in time and perform recovery using the restored online redo logs. Typically, this means there will be missing transactions (data loss) as any data modifications done between the recovery destination time and the present are lost. In many cases, this is the desirable goal because there may have database changes that caused corruption and needs to be undone. Recovering to a point in the past is a way to remove those unwanted changes.

The point-in-time restore process of an Oracle database involves restoring all the data files, redo logs, control files, and the archived redo logs back to the same location. The total time to recover the database depends on its size and the backup restore strategy used. Using EqualLogic Smart Copy Snapshots can greatly reduce the restore time as the restore process occurs on the array without the need for external media.

To perform a point-in-time restore and recovery of an Oracle database using a Smart Copy snapshot, the snapshot must contain all the data files, control files, online redo logs, and archived redo logs.

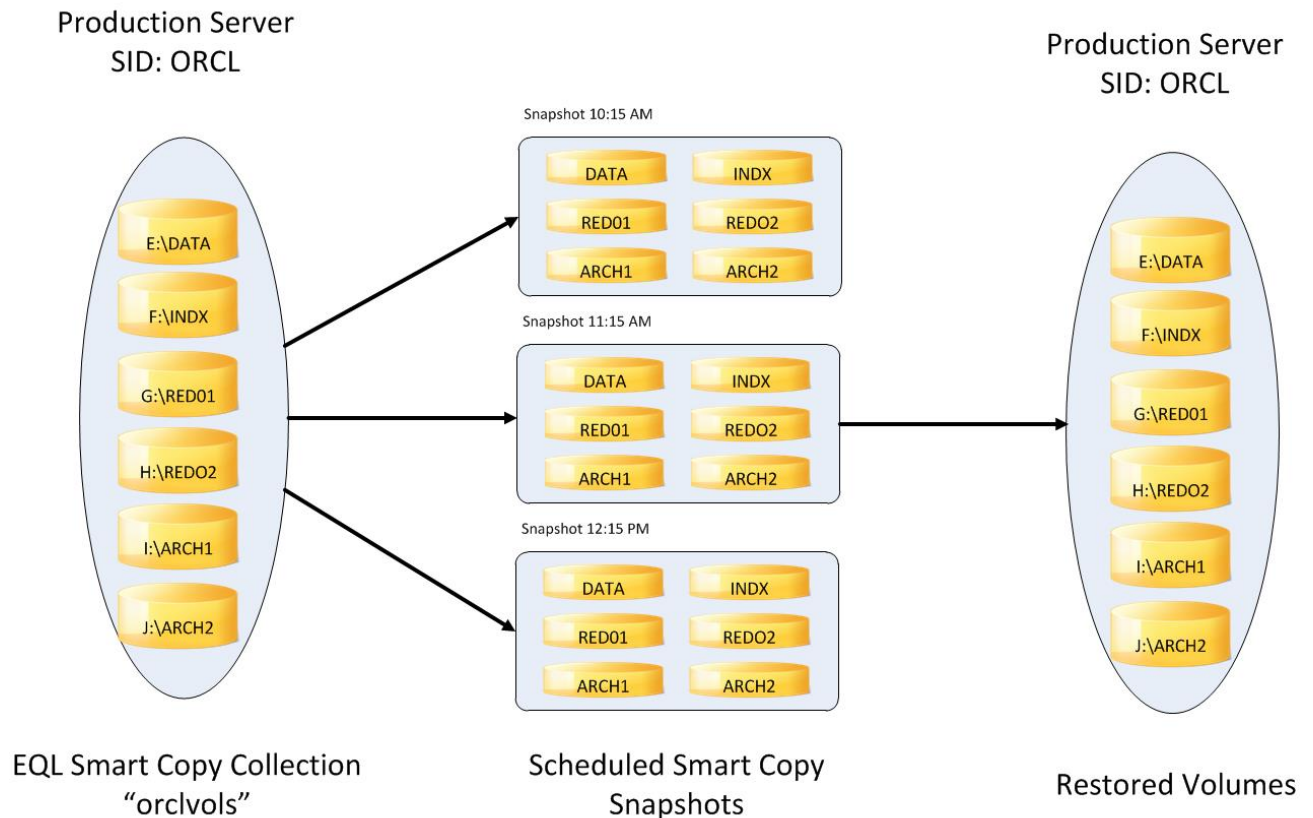


Figure 3 Smart Copy snapshot contents

The scenario in Figure 3 illustrates a data corruption issue between the 10:15 AM and 12:15 PM snapshots. The database needs to be completely restored using the last known good Smart Copy snapshot at

11:15pm, determined by testing. Based on a pre-determined recovery point objectives, it is acceptable to lose the transaction data after the 11:15 AM snapshot for this application.

To perform the point-in-time recovery in this situation, the Smart Copy snapshot from 11:15 AM was restored. This snapshot contains a collection of volumes that comprise the database, including the archive redo logs. Restoring this snapshot returned the existing data files, control files, and online redo logs of the database to the state they were in at the time the 11:15 AM snapshot was taken.

Note: For complete information on Oracle backup and recovery strategies, please see the [Oracle Backup and Recovery Users Guide](#).

The following process can be used to perform a full Oracle database point in time recovery on the database server using an EqualLogic Smart Copy Snapshot. Use the EQL Smart Copy Snapshot for the restore portion of the process and RMAN to perform the database recovery.

Step 1: Stop the Oracle database using the SQLPlus **shutdown abort** command as quickly as possible. Using shutdown abort is not the appropriate way to cleanly shutdown the database, but is necessary when the database has been found to have corrupted data and needs to be shut down quickly. The shutdown abort command aborts all active sessions, de-allocates the Oracle system global area, and terminates all the background processes as quickly as possible. Alternatively, the shutdown normal method waits for in-flight transactions to complete (which could take hours). The shutdown immediate method terminates all sessions and attempts a rollback on the uncommitted transactions.

```
[VM1-ORACLEDBSER] PS C:\>sqlplus "connect / as sysdba"

SQL*Plus: Release 11.2.0.1.0 Production on Tue Jul 8 10:32:07 2014

Copyright (c) 1982, 2010, Oracle. All rights reserved.

Enter password:

Connected to:
Oracle Database 11g Enterprise Edition Release 11.2.0.1.0 - 64bit Production
With the Partitioning, OLAP, Data Mining and Real Application Testing options

SQL> shutdown abort;
ORACLE instance shut down.
SQL>
```



Step 2: (Optional) Stop the Oracle database service on the production server by issuing the following PowerShell command set:

```
[VM1-ORACLEDBSER] PS C:\>get-service OracleServiceOrcl | stop-service
```

Note: Recall that the Oracle database service name is "OracleService<SID>".

Then, verify that the Oracle database service is shutdown with the **get-service** command:

```
[VM1-ORACLEDBSER] PS C:\>get-service OracleServiceOrcl
```

Status	Name	DisplayName
-----	----	-----
Stopped	OracleServiceORCL	OracleServiceOrcl

Step 3: Disable any scheduled backup for the Oracle database using the Oracle Enterprise Manager or Windows Task Scheduler utility GUI or command line for user defined backup scripts. The following steps provide an example of using the Windows Task Scheduler command line to disable a user defined backup.

1. Get the status of the backup task named Orcl Snapshot Script.

```
[VM1-ORACLEDBSER] PS C:\>schtasks /tn "Orcl Snapshot Script"
```

Folder: \	TaskName	Next Run Time	Status
=====	=====	=====	=====
	Orcl Snapshot Script	7/8/2014 12:15:00 PM	Ready

2. Disable the backup script from running.

```
[VM1-ORACLEDBSER] PS C:\>schtasks /tn "Orcl Snapshot Script" /change /disable  
SUCCESS: The parameters of scheduled task "Orcl Snapshot Script" have been changed.
```

3. Verify that the task has been successfully disabled.

```
[VM1-ORACLEDBSER] PS C:\>schtasks /tn "Orcl Snapshot Script"
```

Folder: \	TaskName	Next Run Time	Status
=====	=====	=====	=====
	Orcl Snapshot Script	N/A	Disabled



Step 4: Identify the specific EqualLogic Smart Copy to be used for the database restore by issuing the following EqualLogic get-ASMSmartCopy command.

```
[VM1-ORACLEDBSER] PS C:\>Get-ASMSmartCopy -ObjectName "collection{orclvols}" | ft -
Property SmartCopyName,ObjectName -AutoSize
```

SmartCopyName	ObjectName
-----	-----
orclvols (7/7/2014 5:15:09 AM)	SnapshotSet{68f6f738-e178-4c08-8076-a19d267510e0}
orclvols (7/7/2014 6:15:09 AM)	SnapshotSet{bd56577b-4a06-4235-9da2-502b2aefcfe5}
orclvols (7/7/2014 7:15:10 AM)	SnapshotSet{1d1be3ac-aa7b-4726-9449-b6df17f43694}
orclvols (7/7/2014 8:15:09 AM)	SnapshotSet{176a0c3f-c5aa-4c11-b31b-1394a84e6e1f}
orclvols (7/7/2014 9:15:09 AM)	SnapshotSet{82eaf86f-0330-43e4-bb88-4e2767593e8a}
orclvols (7/7/2014 10:15:09 AM)	SnapshotSet{d061c19b-719b-443d-94a8-2c94a4fbbc0b}
orclvols (7/7/2014 11:15:09 AM)	SnapshotSet{06989553-a8d2-485c-9f49-98b79b99ba85}
orclvols (7/7/2014 12:15:09 PM)	SnapshotSet{b915e288-37c8-4c31-ba23-2be00b503794}

In the example, the snapshot from 11:15 AM represents the last known good state of the database.

Step 5: Restore the database using the ObjectName of the last known good Smart Copy snapshot of the database with the following EQL ASM PowerShell command.

```
[VM1-ORACLEDBSER] PS C:\> Restore-ASMSmartCopy -ObjectName "SnapshotSet{06989553-a8d2-485c-9f49-98b79b99ba85}" -ErrorAction Stop
```

<command output>

Waiting for the agent...

Starting operation...

Restoring \\10.124.4.78\teamshare\ProgramData\EqualLogic\VSS

Requestor\Shadows\Collection{orclvols}\06989553-a8d2-485c-9f49-98b79b99ba85.bcd...

Successfully restored \\10.124.4.78\teamshare\ProgramData\EqualLogic\VSS

Requestor\Shadows\Collection{orclvols}\06989553-a8d2-485c-9f49-98b79b99ba85.bcd

Note: Prior to running the above commands, ensure that the EQLASMPSTools module has been imported into the PowerShell session. To import this module run the following command:
import-module -module "c:\program files\equallogic\bin\EQLASMPSTools.dll"

Step 6: After the database has been restored from the snapshot, restart the Oracle database service on the database server.

```
[VM1-ORACLEDBSER] PS C:\>start-service OracleServiceOrcl
```

<command output>

WARNING: Waiting for service 'OracleServiceOrcl (OracleServiceORCL)' to start...

WARNING: Waiting for service 'OracleServiceOrcl (OracleServiceORCL)' to start...



WARNING: Waiting for service 'OracleServiceOrcl (OracleServiceORCL)' to start...

Verify that the service has started successfully.

```
[VM1-ORACLEDBSER] PS C:\>get-service OracleServiceOrcl
```

Status	Name	DisplayName
-----	----	-----
Running	OracleServiceORCL	OracleServiceOrcl

Step 7: Use the RMAN utility to recover the restored database to the desired point-in-time.

1. Open an RMAN session.

```
[VM1-ORACLEDBSER] PS C:\>rman target /
```

```
Recovery Manager: Release 11.2.0.1.0 - Production on Tue Jul 8 14:56:11 2014

Copyright (c) 1982, 2009, Oracle and/or its affiliates. All rights reserved.

connected to target database (not started)
```

2. Use RMAN to startup and mount the database.

```
RMAN> startup mount;
```

```
Oracle instance started
database mounted
```

```
Total System Global Area      3340451840 bytes
```

```
Fixed Size                      2180344 bytes
```

```
Variable Size                   1476397832 bytes
```

```
Database Buffers                1845493760 bytes
```

```
Redo Buffers                    16379904 bytes
```

3. Recover the database using the RMAN **recover database** command.

```
RMAN> recover database;
```

```
Starting recover at 08-JUL-14
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=63 device type=DISK
```

```
starting media recovery
media recovery complete, elapsed time: 00:00:15
```

```
Finished recover at 08-JUL-14
```



The RMAN “recover database” command will replay the archived and online redo logs and bring the database to the desired SCN. It will also take the restored database out of hot backup mode.

4. After the database has been recovered, open the database and exit the RMAN utility.

```

RMAN> alter database open;

database opened

RMAN> exit

Recovery Manager complete.

[VM1-ORACLEDBSER] PS C:\>
```

This completes the database point-in-time restore. The database is at the condition it was in at the time of the 11:15 AM snapshot.

Step 8: Re-enable scheduled snapshot scripts using Windows Task Scheduler GUI or the following command.

```
[VM1-ORACLEDBSER] PS C:\>schtasks /tn "Orcl Snapshot Script" /change /enable
```

Verify that the script schedule has been re-enabled successfully

```
[VM1-ORACLEDBSER] PS C:\>schtasks /tn "Orcl Snapshot Script"
```

```
Folder: \
TaskName                                     Next Run Time                               Status
=====
Orcl Snapshot Script                         7/8/2014 5:15:00 PM                         Ready
```

3.3.4 Oracle database complete restore with EqualLogic Smart Copy

Unlike a point-in-time restore and recovery that brings the database to a past point-in-time, a complete restore and recovery of the Oracle database brings the database to a state where it is fully up-to-date. This includes all of the committed data modifications to the present time. The complete restore and recovery of a database is a zero data loss recovery. It is useful when a critical database component (such as a data file, control file, or redo log) is lost resulting from user error, application error, or media failure. Perform a complete restore when the database cannot start or has crashed due to the loss of a critical component.

A complete database restore and recovery uses the same process demonstrated with the point-in-time restore and recovery in section 3.3.3 with one major exception: the restore snapshot used cannot contain the database redo logs and archive redo logs. In complete recovery and restore, only the database data files are restored from a snapshot. The redo logs and archived redo logs must remain current as they need to be replayed in order to bring the database up to the present state. Restoring the log volumes from the snapshot overwrites the committed transactions since the time the snapshot was taken. This renders it impossible to recover the database to the present time.



Two methods use EqualLogic storage and tools to help facilitate the complete restore and recovery of an Oracle database by preserving the committed transactions on the log volumes:

- Using a separate volume collection containing only the database data volumes
- Using an existing volume collection containing all of the Oracle database volumes

3.3.4.1 Using a separate volume collection

The first method is to create a separate ASM Smart Copy volume collection that contains only the data volumes. In the event of a complete restore and recovery, a snapshot of this data volume collection could be restored, preserving the current log volumes. The log volumes are then replayed using RMAN recovery.

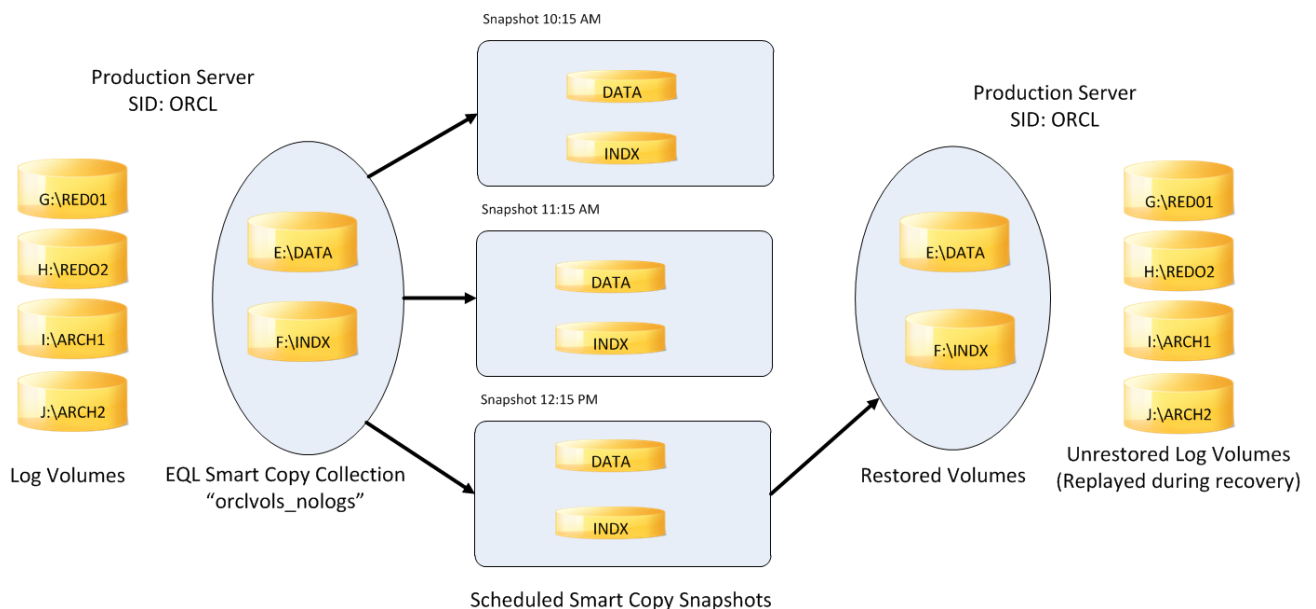


Figure 4 Restoring only the data volumes

This method of using a second Smart Copy collection of only the data volumes for the Oracle database follows the same process shown in section 3.3.3 for the point-in-time restore. The only significant difference will be the time RMAN takes to complete the recover database command in Step 7 of the process. The length of time required to complete this step is determined by the number of logs that need to be replayed to bring the database to the current time.

Note: This method could consume Snapshot reserve space at a much faster pace on the EqualLogic array as the data volumes could be part of multiple volume collections that are subject to multiple snapshot schedules. Careful attention to snapshot reserve space on the EqualLogic array needs to be taken if this method is employed.

3.3.4.2 Using an existing volume collection

The second complete restore and recovery method described in this paper utilizes the existing volume collection comprising all of the volumes in the database. The individual data volumes are restored by examining a Smart Copy snapshot of the entire collection, then identifying and restoring only the associated snapshots for the data volumes on the EqualLogic array. This method uses a combination of the ASM/ME GUI to identify the individual volume snapshots in the Smart Copy for the collection. The EqualLogic Array PowerShell commands are then used to restore the snapshots for only the data volumes. The log volumes are not be restored, and are replayed during the recovery process to bring the database back up to the present state.

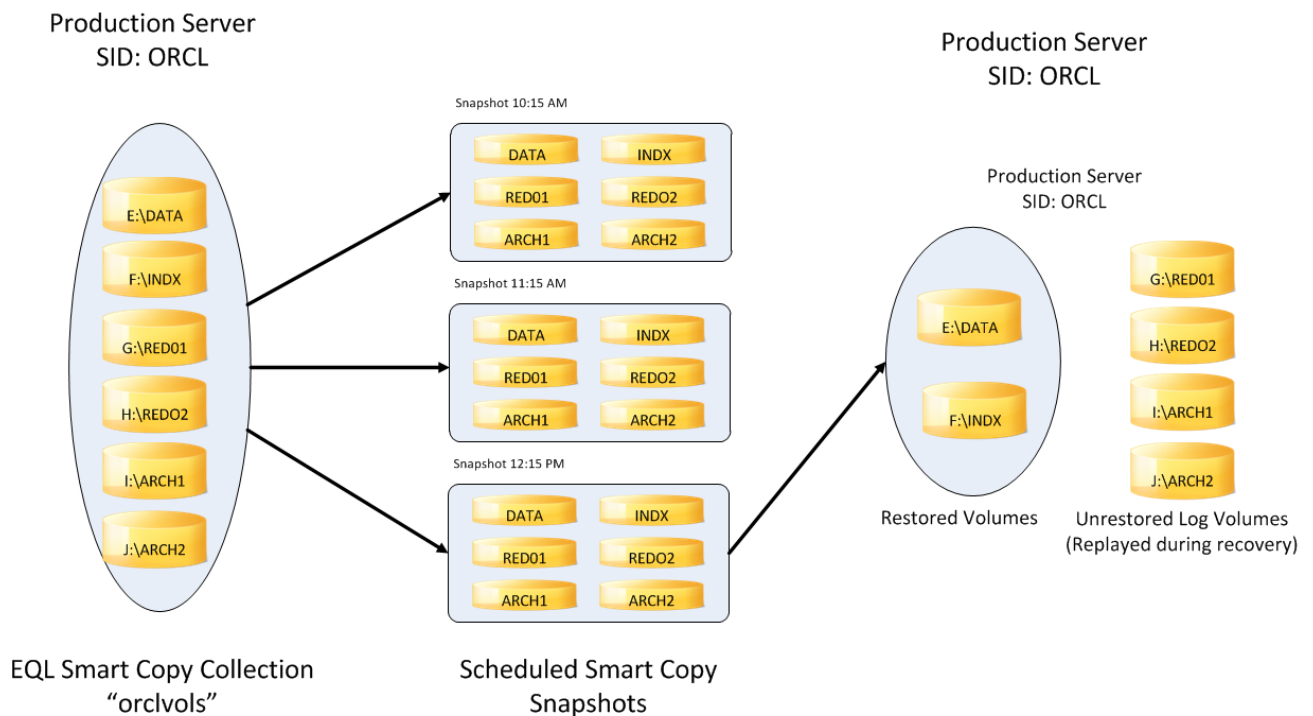


Figure 5 Restore and recovery using the existing volume collection with volumes in the database

This method of performing a complete restore and recovery has an advantage over the previous method because it uses the same volume collection and associated Smart Copies that are used with a point-in-time restore and recovery process. This means that there is a single volume collection to manage and no need to create multiple snapshots of the data volumes that rapidly consume the snapshot reserve space on the array. The process involved in performing this type complete recovery and restore of the database requires some extra steps that are illustrated in the following pages.

Steps 1, 2, and 3 are identical to the steps listed in Section 3.3.3.

- [Step 1: If running, stop the Oracle database on the database server.](#)
- [Step 2: \(Optional\) Stop the Oracle Service on the database server.](#)
- [Step 3: Disable any scheduled backups for the Oracle database.](#)

Step 4: Using ASM/ME GUI, examine the properties of the selected Smart Copy to be used for the restore operation.

Open ASM/ME on the database server, and select a Smart Copy of the collection. In the example below, the 12:15PM Smart Copy of the orclvols collection is selected. By selecting the Smart Copy, its properties are shown in the frame to the right of the navigation tree. In the properties window, the names of the associated volume snapshots on the EqualLogic PS array are displayed. Identify the names of the snapshots associated with the data volumes in the collection Smart Copy. In the example, the associated snapshots for the oradata and oraindx volumes are identified.

The screenshot shows the Dell EqualLogic Auto-Snapshot Manager interface. On the left, a navigation tree under 'Hosts (1)' shows the path: vm1-oracledbserve > Applications > Volumes > Collections > orclvols > Smart Copies > orclvols. A red arrow points to the selected Smart Copy: '7/10/2014 12:15:07 PM'. The right pane displays the 'Smart Copy of orclvols on vm1-oracledbserve' properties.

Properties	
Smart Copy created	7/10/2014
Original object	Collection{orclvols}
Originating computer	VM1-OracleDBServ.SKYNET.lab.local
VSS Snapshot Set ID	e473e07f-6a6e-4e1c-8ea8-76361a3d5534
Backup type	Copy
Smart Copy type	Snapshot
Partial file support	False
Select components	True
Number of Smart Copies	6
Imported Smart Copies	0
Exposed Smart Copies	0
Created by	Administrator

Mappings on VM1-OracleDBServ	
Snapshots	
PS Volume #1	oradata-2014-07-10-12:06:57.3848.1
PS Volume #2	oraindx-2014-07-10-12:06:57.3849.1
PS Volume #3	oraredo1-2014-07-10-12:06:58.3851.1
PS Volume #4	oraredo2-2014-07-10-12:06:58.3852.1
PS Volume #5	oraarch1-2014-07-10-12:06:58.3853.1
PS Volume #6	oraarch2-2014-07-10-12:06:58.3854.1

Note: The name of the volume snapshot from the PS array includes the time stamp of when it was created. This time stamp will not always match up with the time stamp shown for the associated Smart Copy. This is because the snapshot time stamp is using the time on the PS array, which could be different from the time associated with the database server (the source of the time stamp for the Smart Copy itself). This difference is in name only. The time stamp on the Smart Copy shown in ASM/ME always reflects the time the Smart Copy was taken on the database server.



Step 5: Restore the data volumes from the array snapshots using EqualLogic PS Tools PowerShell commands.

In the ASM/ME GUI, copy the name of the associated snapshot for the data volumes from the collection Smart Copy and paste it into the EQLPSTools **restore-EQLSnapshot** PowerShell command as shown below. Repeat this for every data volume being restored. In the example, the volumes "oradata" and "oraindx" are the restored volumes. The copy and pasted name of the associated snapshot is used for the -SnapshotName parameter for each volume.

```
[VM1-ORACLEDBSER] PS C:\>Restore-EqlSnapshot -VolumeName oradata -SnapshotName
oradata-2014-07-10-12:06:57.3848.1
PsApiCmdletCommon.RestoreSnapshot oradata-2014-07-10-12:06:57.3848.1 completed
successfully.
```

```
[VM1-ORACLEDBSER] PS C:\>Restore-EqlSnapshot -VolumeName oraindx -SnapshotName
oraindx-2014-07-10-12:06:57.3849.1
PsApiCmdletCommon.RestoreSnapshot oraindx-2014-07-10-12:06:57.3849.1 completed
successfully.
```

Note: Prior to running the above commands, ensure that the EQLPSTools module has been imported into the PowerShell session. To import this module run the following command:
import-module -module "c:\program files\equallogic\bin\EQLPSTools.dll"

Step 6: Reconnect and rescan the iSCSI targets on the database server.

The restoring of the data volumes from the snap shot temporarily takes them offline. The volumes need to be manually rescanned and reconnected to the database server after the restore completes.

Note: The iSCSI rescan did not have to be performed in Section 3.3.3 because the restore was run using the EQLASMPSTools module, whose commands interact with the host agent on the database server and perform the rescan behind the scenes. The EQLPSTools commands interact only with the array and not with the host where they are run.

To manually rescan and reconnect the data volumes, run the following command set from the database server:

1. Update the iSCSI targets.

```
[VM1-ORACLEDBSER] PS C:\>Update-IscsiTarget
```

2. After the command completes, examine the iSCSI target status with the get-iSCSTarget command.

```
[VM1-ORACLEDBSER] PS C:\>Get-IscsiTarget | ft -AutoSize
```

```
IsConnected NodeAddress
-----
True iqn.2001-05.com.equallogic:0-...-d8600000042522f7-vss-control
```



```
False iqn.2001-05.com.equallogic:0-...-69cbc512c4b538f7-oradata
False iqn.2001-05.com.equallogic:0-...-dabbc512c4e538f7-oraindx
True iqn.2001-05.com.equallogic:0-...-121bc512c54538f7-oraredol
...
```

This output shows that the two data volumes (oradata and oraindx) can be seen but are not connected as iSCSI targets to the database server (False value in the IsConnected parameter). To reconnect these volumes as iSCSI targets to the database, run the following PowerShell one-line command.

```
[VM1-ORACLEDBSER] PS C:\>Get-IscsiTarget | ? {$_.IsConnected -eq $false} |
% {$_ | Connect-IscsiTarget}
```

<command output>

```
AuthenticationType      : NONE
InitiatorInstanceName   : ROOT\ISCSIPRT\0000_0
InitiatorNodeAddress     : iqn.1991-05.com.microsoft:vm1-
oracledbserv.skynet.lab.local
InitiatorPortalAddress   : 0.0.0.0
InitiatorSideIdentifier  : 400001370000
IsConnected             : True
...
```

```
AuthenticationType      : NONE
InitiatorInstanceName   : ROOT\ISCSIPRT\0000_0
InitiatorNodeAddress     : iqn.1991-05.com.microsoft:vm1-
oracledbserv.skynet.lab.local
InitiatorPortalAddress   : 0.0.0.0
InitiatorSideIdentifier  : 400001370000
IsConnected             : True
...
```

This command identifies unconnected iSCSI targets and then passes them as objects into a foreach loop (designated by the % symbol). In the loop, each individual object (volume) is reconnected it to the database server.

3. Examine the iSCSI targets again to verify the data volumes ("oradata" and "oraindx") are now connected to the database server.

```
[VM1-ORACLEDBSER] PS C:\>Get-IscsiTarget | ft -AutoSize
```

```
IsConnected NodeAddress
-----
True iqn.2001-05.com.equallogic:0-...-d8600000042522f7-vss-control
True iqn.2001-05.com.equallogic:0-...-69cbc512c4b538f7-oradata
True iqn.2001-05.com.equallogic:0-...-dabbc512c4e538f7-oraindx
True iqn.2001-05.com.equallogic:0-...-121bc512c54538f7-oraredol
...
```



4. Update the host storage cache (rescan devices). This remounts the volumes to their original locations on the database server.

```
[VM1-ORACLEDBSER] PS C:\>Update-HostStorageCache
```

5. Use either Windows Server Manager or the **get-volume** PowerShell command to verify the data volumes have been remounted using their appropriate drive letters.

```
[VM1-ORACLEDBSER] PS C:\>Get-Volume | ft -AutoSize
```

DriveLetter	FileSystemLabel	FileSystem	DriveType	HealthStatus	SizeRemaining	Size
	System Reserved	NTFS	Fixed	Healthy	89.12 MB	350 MB
E	oradata	NTFS	Fixed	Healthy	241.28 GB	249.88 GB
F	oraindx	NTFS	Fixed	Healthy	48.61 GB	48.71 GB
...						

Step 7: After the database has been restored from the snapshot, restart the Oracle database service on the database server.

```
[VM1-ORACLEDBSER] PS C:\>start-service OracleServiceOrcl
```

<command output>

```
WARNING: Waiting for service 'OracleServiceOrcl (OracleServiceORCL)' to start...
WARNING: Waiting for service 'OracleServiceOrcl (OracleServiceORCL)' to start...
WARNING: Waiting for service 'OracleServiceOrcl (OracleServiceORCL)' to start...
```

Verify that the service has started successfully.

```
[VM1-ORACLEDBSER] PS C:\>get-service OracleServiceOrcl
```

Status	Name	DisplayName
Running	OracleServiceORCL	OracleServiceOrcl

Step 8: Use the RMAN utility to completely recover the restored database.

1. Open an RMAN session.

```
[VM1-ORACLEDBSER] PS C:\>rman target /
```

```
Recovery Manager: Release 11.2.0.1.0 - Production on Tue Jul 8 14:56:11 2014
```

```
Copyright (c) 1982, 2009, Oracle and/or its affiliates. All rights reserved.
```

```
connected to target database (not started)
```



2. Use RMAN to startup and mount the database.

```
RMAN> startup mount;
```

```
Oracle instance started  
database mounted
```

```
Total System Global Area      3340451840 bytes
```

```
Fixed Size                      2180344 bytes
```

```
Variable Size                   1476397832 bytes
```

```
Database Buffers                1845493760 bytes
```

```
Redo Buffers                    16379904 bytes
```

3. Recover the database using the RMAN **recover database** command.

```
RMAN> recover database;
```

```
Starting recover at 08-JUL-14  
using target database control file instead of recovery catalog  
allocated channel: ORA_DISK_1  
channel ORA_DISK_1: SID=63 device type=DISK
```

```
starting media recovery
```

```
archived log for thread 1 with sequence 2656 is already on disk as file
```

```
J:\APP\ADMINISTRATOR\ORADATA\ARC0000002656_0849371864.0001
```

```
archived log for thread 1 with sequence 2657 is already on disk as file
```

```
J:\APP\ADMINISTRATOR\ORADATA\ARC0000002657_0849371864.0001
```

```
archived log for thread 1 with sequence 2658 is already on disk as file
```

```
J:\APP\ADMINISTRATOR\ORADATA\ARC0000002658_0849371864.0001
```

```
archived log for thread 1 with sequence 2659 is already on disk as file
```

```
J:\APP\ADMINISTRATOR\ORADATA\ARC0000002659_0849371864.0001
```

```
archived log for thread 1 with sequence 2660 is already on disk as file
```

```
J:\APP\ADMINISTRATOR\ORADATA\ARC0000002660_0849371864.0001
```

```
archived log for thread 1 with sequence 2661 is already on disk as file
```

```
J:\APP\ADMINISTRATOR\ORADATA\ARC0000002661_0849371864.0001
```

```
archived log for thread 1 with sequence 2662 is already on disk as file
```

```
J:\APP\ADMINISTRATOR\ORADATA\ARC0000002662_0849371864.0001
```

```
archived log file name=J:\APP\ADMINISTRATOR\ORADATA\ARC0000002656_0849371864.0001
```

```
thread=1 sequence=2656
```

```
archived log file name=J:\APP\ADMINISTRATOR\ORADATA\ARC0000002657_0849371864.0001
```

```
thread=1 sequence=2657
```

```
archived log file name=J:\APP\ADMINISTRATOR\ORADATA\ARC0000002658_0849371864.0001
```

```
thread=1 sequence=2658
```

```
archived log file name=J:\APP\ADMINISTRATOR\ORADATA\ARC0000002659_0849371864.0001
```

```
thread=1 sequence=2659
```

```
archived log file name=J:\APP\ADMINISTRATOR\ORADATA\ARC0000002660_0849371864.0001
```

```
thread=1 sequence=2660
```

```
media recovery complete, elapsed time: 00:01:15
```

```
Finished recover at 10-JUL-14
```



In the complete recovery, the RMAN **recover database** command replays all the archived and online redo logs and brings the database to the present time. It also takes the restored database out of hot backup mode.

4. Open the database and exit the RMAN utility.

```

RMAN> alter database open;

database opened

RMAN> exit

Recovery Manager complete.

[VM1-ORACLEDBSER] PS C:\>

```

This finishes the database complete restore. The completely recovered database reflects the present time with zero data loss.

Step 9: Re-enable scheduled database snapshot scripts using Windows Task Scheduler GUI or the following command.

```
[VM1-ORACLEDBSER] PS C:\>schtasks /tn "Orcl Snapshot Script" /change /enable
```

Verify that the script schedule has been re-enabled successfully

```
[VM1-ORACLEDBSER] PS C:\>schtasks /tn "Orcl Snapshot Script"
```

```

Folder: \
TaskName
=====
Orcl Snapshot Script
Next Run Time
=====
7/8/2014 5:15:00 PM
Status
=====
Ready

```



4 Conclusion

Being able to quickly restore and recover data is an essential part of Oracle database administration. This paper has demonstrated solutions for four Oracle database restore and recovery scenarios on the Windows Server platform. These solutions take advantage of the native functionality provided by the Oracle ODP.NET and RMAN utilities, Windows PowerShell, and Dell EqualLogic storage and Host Integration Tools for Microsoft V4.7. As always, any backup and recovery solution is only as good as the amount of thorough verification testing performed prior to the time in which is actually needed. The solutions presented in this paper augment (not replace) an already existing and proven long term Oracle backup and recovery solution.



A Sample PowerShell script

This sample PowerShell script creates EqualLogic Smart Copy Snapshots of a running Oracle database on a Windows Server.

```
<#
.SYNOPSIS
This is sample script will perform a hot backup of a running Oracle database on a Windows
  Server platform using ODP.NET from Oracle and Dell EqualLogic Host Integration
  Toolkit for Microsoft V4.7

.DESCRIPTION
There are two main components used in this script:
1) Oracle Data Provider .NET (ODP.NET)
2) EqualLogic's Host Integration Tools for Micorsoft V4.7 - specifically the new
  ASMPSTools
  PowerShell library

Oracle Data Provider for .NET (ODP.NET) provides fast data access from .NET clients to
  Oracle databases. ODP.NET enables .NET applications to take advantage of Oracle
  advanced features, such as Oracle Real Application Clusters (Oracle RAC) and XML DB. It
  is accessible through any .NET language, including C# and PowerShell which is built on
  the .NET framework. The ODP.NET is a fully supported method by Oracle for a .NET
  application or utility to connect and manage an Oracle database.

It uses the new EQLASMPSTool PowrShell commandlets provided by HIT/ME V4.7 to create a
  Smartcopy
of the Oracle database volume collection while the database is in hotbackup mode.

The work flow of the script is as follows:
1) Load required EQL PowerShell Modules
2) Check to see if EQL Services are running on the Oracle database server
3) Verify that the HIT/Microsoft version is 4.7 or above
4) Load specific variables which include Oralce instance name, User, and password
  Note: this will be enhanced in a future version to read from an XML file and prompt
  the user for the
  Oracle user credential
4) Load the ODP.NET dll from $oracle_home\dbhome_1\ODP.NET\bin\2.x
5) Open a connection to the database
6) Check to make sure the database is in archive mode
7) Place the database in hot back up mode
8) Create an EQL Smartcopy of the Oracle database volume collection
9) Take the database out of hot backup mode
10) Archive the current redo log

.Requirements
1) This script is intended to be run from the Oracle database server or from a remote
  powershell connection
  to the Oracle database server.
```



```

2) Oracle Database V11gR2 or greater
3) EqualLogic Host Integration Tools for Microsoft V4.7 or greater

#>

#####
#Import required modules

Set-StrictMode -Version Latest
$ErrorActionPreference = "Stop"

Import-Module -Name "c:\program files\equallogic\bin\EqlASMPSTools.dll"
Import-Module -Name "c:\program files\equallogic\bin\EqlPSTools.dll"

cls

#####
#Verify that EQL Services are running on Hyper-V Host. Restart if necessary
#####

Write-Host "Checking to see if required EqualLogic services are running`n"
Get-Service | Where-Object {$_.displayname -like "Equal*"}

#Restart any stopped EQL Services
Get-Service | Where-Object {$_.displayname -like "Equal*"} | % {
    if($_.Status -eq "Stopped") {
        Write-Host "`nRestarting..."
        write-host $_.DisplayName
        Start-Service $_.name
    }
}
Write-Host "`nAll EqualLogic services started`n"

#####
#Check HIT/Microsoft Verison
#####

if ((Get-ASMVersion).version -lt "4.7") { echo "HIT/Microsoft 4.7 or greater
required.`nLoad HIT/Microsoft 4.7 and rerun script."; break}

#####
#Create Variables to hold information for particular Oracle DB.
#Future version of script will read these variable in from XML file
#####

<#
Variable and definitions

$TNSAlias = "oradb1"                                #Name of Oracle DB TNSAlias
$OraHost = "vm1-oracledbser.skynet.lab.local"        #Name of Oracle DB Server"

```



```

$OraEQLVolCollection = "Collection{oradb1_data_logs}"      #Name of EQL Volume Collection
    for Oracle DB
$OraUser = "system"                                       #Database user name
$OraUserPW = "Passw0rd"                                   #Database user password (never
    a good idea to have in the clear)
$SQLCommand1 = "alter database begin backup"             #SQL Statement to begin hot
    backup mode
$SQLCommand2 = "alter database end backup"               #SQL Statement to end hot
    backup mode
$SQLCommand3 = "alter system archive log current"        #SQL Statement to archive
    current redo log

#>

$TNSAlias = "orcl"                                       #Name of Oracle DB SID TNSAlias
$OraHost = "vml-oracledbser.skynet.lab.local"           #Name of Oracle DB Server"
$OraEQLVolCollection = "Collection{orclvols}"            #Name of EQL ASM Collection for
    all Oracle DB volumes
$OraEQLDATAINDXCollection = "Collection{orclvols_nologs}" #Name of EQL ASM Collection
    just for Oracle DB DATA and INDX volumes
$OraUser = "system"                                       #Database user name
$OraUserPW = "Passw0rd"                                   #Database user password (never
    a good idea to have in the clear)
$SQLCommand1 = "alter database begin backup"             #SQL Statement to begin hot
    backup mod
$SQLCommand2 = "alter database end backup"               #SQL Statement to end hot
    backup mode
$SQLCommand3 = "alter system archive log current"        #SQL Statement to archive
    current redo log

#####
#Connect to an Oracle Database Using ODP.NET and place into hot backup mode

<#

Info on ODP.NET can be found on Oracle Technetwork at:
http://www.oracle.com/technetwork/topics/dotnet/index-085163.htm

also on using PowerShell with ODP.NET from Scripting Guys Blog:
http://blogs.technet.com/b/heyscriptingguy/archive/2012/12/04/use-oracle-odp-net-and-
    powershell-to-simplify-data-access.aspx

and at:
http://guyharrison.typepad.com/yadb/2008/01/accessing-orac1.html

#>

#####
# Load the Oracle ODP.NET assembly

```



```

[reflection.assembly]::LoadFile("c:\app\administrator\product\11.2.0\dbhome_1\ODP.NET\bin
\2.x\Oracle.DataAccess.dll")

#Attempt to open a connection to the Oracle DB. Catch error if conection fails

try {

    #$con = New-Object Oracle.DataAccess.Client.OracleConnection("User
ID=$OraUser,Password=$OraUserPW;Data Source=$TNSAlias")
    $constr = "User Id=$orauser;Password=$orauserpw;Data Source=$TNSAlias"
    $con= New-Object Oracle.DataAccess.Client.OracleConnection($constr)
    $con.open()

    "Connected to database: {0} running on host: {1} - Servicename: {2} - Serverversion:
{3}" -f `
    $con.DatabaseName, $con.HostName, $con.ServiceName, $con.ServerVersion

} catch {

    Write-Error("Miserable Failure. Can't open connection: {0}`n{1}" -f `
    $con.ConnectionString, $_.Exception.ToString())
    break
}

#####
#Optional - Place holder for code to check to make sure the database is in ArchiveLog
#Mode
#
#
#
#####

#Place Database into hot backup mode
$hotbackupcmd = new-Object Oracle.DataAccess.Client.OracleCommand($SQLCommand1,$con)
$reader=$hotbackupcmd.ExecuteReader()

#Close Database Connection
$con.close()

#####
#Get ASM Collection for Oracle Database Volumes and take Smart Copy
#####

New-ASMSmartCopy -ObjectName "$OraEQLVolCollection" -SmartCopyType snapshot -scheduleID
"orcl_full_snapshot" -KeepCount 24 -ErrorAction stop
#New-ASMSmartCopy -ObjectName "$OraEQLDATAINDXCollection" -SmartCopyType snapshot -
ScheduleID "orcl_DataINDX_Snapshot" -KeepCount 12 -ErrorAction Stop

```




```
#####
#Reconnect to Oracle Database. Take out of hot backup mode and archive current redo log
#####

#Reconnect to database
$con.Open()

#Take Database out of hot backup mode
$sendbackupcmd = new-Object Oracle.DataAccess.Client.OracleCommand($SqlCommand2,$con)
$reader1=$sendbackupcmd.ExecuteReader()

#Archive current Redo log
$archiveredologcmd = new-Object Oracle.DataAccess.Client.OracleCommand($SqlCommand3,$con)
$reader2=$archiveredologcmd.ExecuteReader()

#Close Database Connection
$con.close()
```

