

From The rchitect

A Veeam Architect Paper

Oracle and Veeam

A Modern Data Protection Strategy for
Enterprises

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Executive Summary:

Oracle is a robust object relational database that provides efficient and effective solutions for database users such as delivering high performance, Efficient memory caching to ensure the optimal performance of very large databases, High-performance partitioning to divide larger data tables in multiple pieces, The presence of several methods for hot, cold and incremental backups and recoveries, including the powerful Recovery Manager tool (RMAN) Oracle is the database engine of choice for many large enterprises and health-care service providers to store and manage their mission critical data, The Oracle database is directly related to core business functionality.

It's mission critical for companies to have a proper disaster recovery strategy for an Oracle Database, in case of a disaster the database must be capable of a restore with minimal effort and without any delays.

This paper explains the Oracle database core concepts, Oracle RMAN backup and recovery concepts and options and retention policies. It explains how Veeam Plug-in for Oracle RMAN simplifies backup file management, demystifies database restoration and recovery strategies across multiple platforms. It will enable Oracle DBAs to control and monitor those strategies regardless of experience level.

Veeam provides a single platform that meets the needs of both the infrastructure teams and the granular backup needs of the DBAs. We will discuss recommended best practices for effectively implementing Veeam with Oracle and address how Veeam implements optimal security for offsite backup file storage.

Intended Audience:

This whitepaper is intended for both non-technical and technical functions it is good for IT Administrators, Backup Administrator, Decision makers and any personnel responsible or interested in Veeam Plugin integration with Oracle RMAN for managing and operating. This document describes the features included in Veeam® Backup & Replication™ and Veeam Plugin for Oracle RMAN for performing consistent backups for the Oracle Database in accordance with Veeam and Oracle backup and recovery best practices. The experienced database administrator can skip the sections one and two.

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1. About Oracle Database:

In this section we will discuss about Oracle database key components

- Data Files
- Control Files
- Online redo logs
- Server Parameter files.

1.1 Data Files:

Every Oracle database has one or more physical datafile which contains all the database data. Datafiles are the physical manifestations of the database's tablespaces. They contain database blocks which in turn contain rows of data for tables and indexes. A key tablespace and the UNDO tablespace. It also contains information about uncommitted transactions so that they can be quickly rolled back during transaction processing.

A datafile is created with a tablespace creation and a datafile can associate with only one tablespace.

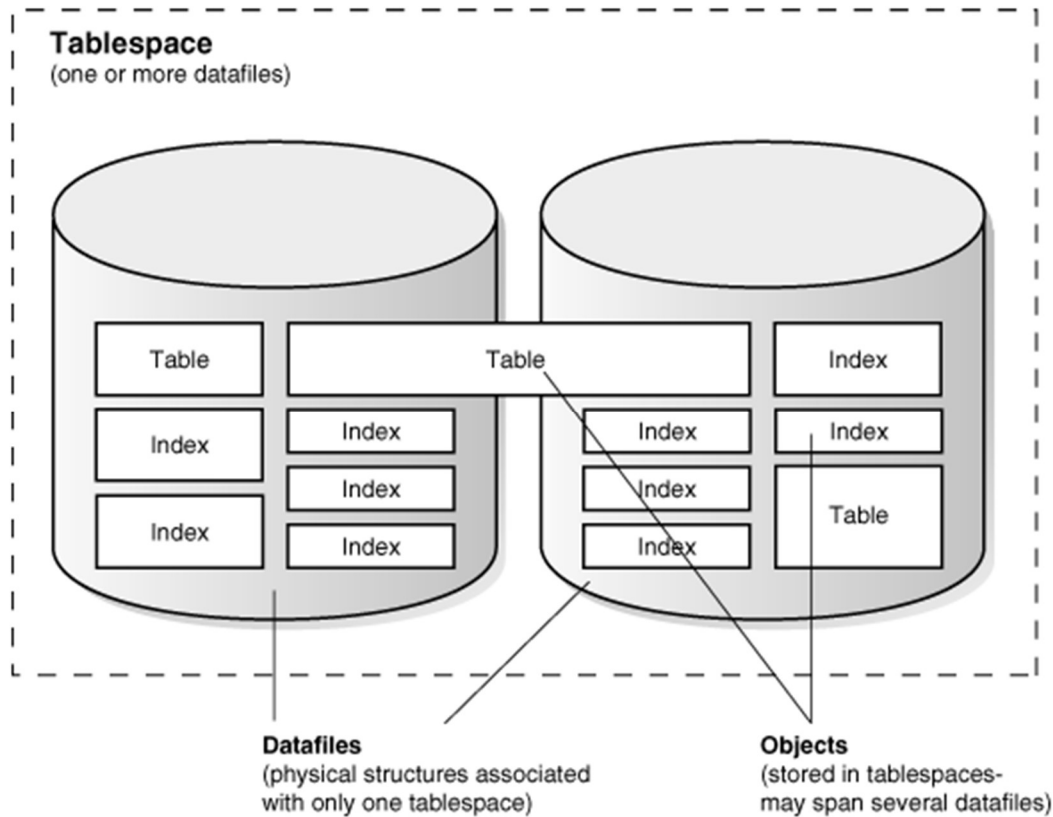


Figure 1: Tablespace datafiles

1.1.1 Default tablespace and datafiles:

Tablespace	Data file	Description
SYSAUX	SYSAUX01.DBF	Serves as an auxiliary tablespace to the SYSTEM tablespace.
SYSTEM	SYSTEM01.DBF	Stores the data dictionary , including definitions of tables, views, and stored procedures needed by the Oracle Database. Information in this area is maintained automatically.
Temp	TEMP01.DBF	Stores temporary tables and indexes created during the processing of your SQL statement. If you are running a SQL statement that involves a lot of sorting, such as the constructs GROUP BY, ORDER BY, or DISTINCT, then you may need to expand this tablespace.

UNDOTBS	UNDOTBS01.DBF	Stores undo information. The undo tablespace contains one or more undo segments that maintain transaction history that is used to roll back, or undo, changes to the database. All starter databases are configured to run in automatic undo management mode.
USERS	USERS01.DBF	Stores database objects created by database users.

For example:

You can create the tablespace named veeam that has four datafiles with the following SQL statement:

```
CREATE TABLESPACE veeam
DATAFILE '/path/veeam1.dat' SIZE 10M;
DATAFILE '/path/veeam2.dat' SIZE 10M;
DATAFILE '/path/veeam3.dat' SIZE 10M;
DATAFILE '/path/veeam4.dat' SIZE 10M;
```

Figure 2: Create Tablespace

1.2 Control File:

Control Files contain crucial information about the underlying physical components of the database, including the online state, location, and recoverability of datafiles and transaction logs. When Oracle Recovery Manager (RMAN) is used to back up critical database physical components, the names, current location and status of those backup files are also retained within the control file. There are usually at least two control files which should be multiplexed across different physical storage to guarantee survivability.

Oracle recommended to keep multiple copies of controlfile, if any controlfile fails the database will become unavailable. The names of the control files are specified by the CONTROL_FILES parameter in the initialization parameter file used during database

creation. The filenames specified in CONTROL_FILES should be fully specified and are operating system specific.

The following is an example of a CONTROL_FILES initialization parameter:

```
CONTROL_FILES = (/u01/oracle/prod/control01.ctl,  
                /u02/oracle/prod/control02.ctl,  
                /u03/oracle/prod/control03.ctl)
```

Figure 3: Control Files Initialization parameter

1.3 Online redo logs:

Every Oracle Database has a set of online redo logs (ORL) , the online redo log stores a copy of the change made to the data. If a failure requires a datafile to be restored from the backup, any recent changes missing from restored data can be obtained from the online redo log file, providing a recovery of the database to consistent state without any loss of any data.

The database log writer process (LGWR) writes redo records from the memory buffer to redo log group. There are usually at least three online redo log member groups, each composed of at least two online redo log members These are typically multiplexed across different physical storage devices to guarantee survivability of transaction logs. As each online redo log fills with transactions, it is automatically switched to the next online redo log group so that transaction processing is not impeded. If the database is in ARCHIVELOG mode (Highly recommended for complete recoverability!), the ORL is immediately written to a secondary location as an Archived Redo Log (ARL).

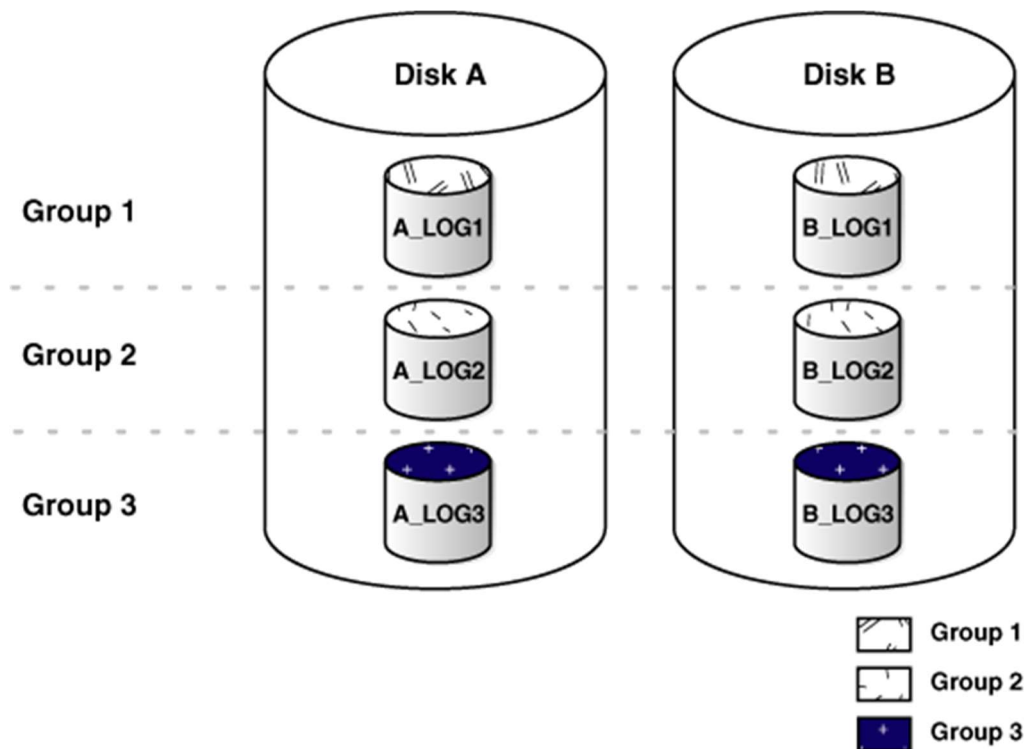


Figure 4 – Oracle redo logs groups

1.4 Server Parameter File:

The Server Parameter File (SPFILE) is a binary file that contains the database and instance-specific settings that determine a plethora of database features including, memory allocations, physical file locations, backup locations, query optimizer features, and other crucial performance-related settings. The SPFILE must be present during the instance startup to locate the database's control files so that they can be opened.

You can check the location of SPFILE with SQL statement:

SQL> show parameter spfile;

This statement shows the name and location of SPFile (Figure 3 for more details)

```
SQL> show parameter spfile;
```

NAME	TYPE	VALUE
spfile	string	/u01/app/oracle/product/19.0.0 /dbhome_1/dbs/spfileveeam.ora

Figure 5 – spfile parameter

2. Oracle Disaster Recovery

In this section, we will discuss about the common failure scenario, backup and recovery options provided by Oracle for clear understanding on how to leverage these critical features to take informed decision to have proper contingency plan and strategy for backup and recovery.

2.1 Common Failures:

The failure can be happens, sometime it is silly mistake by the administrator which change all the database records, or suddenly hardware fails or the storage drive got faulty or the simple application patch corrupt the data, we are going to discuss the common failures for better understanding.

2.1.1 Hardware Failure:

Like the tire of car can puncture at any time, a hardware failure is no different it is hard to predict when the hardware will fail.

Hardware failure is when one of the components of your server breaks or becomes unresponsive. Hardware failures can be caused by CPU, HDD or memory malfunction. Hardware failure downtime can be avoided by using advance high availability technology such as Oracle RAC or using a standby database server to quickly restore the database from the recent backup.

2.1.2 Human Error:

Human error is estimated to be one of the most common factors in database downtime, Human errors can occur due to errors in the application logic, a manual mistake resulting in data changes in the database or deleting the incorrect data.

This type of failure can be handled easily by Oracle Flash Recovery Area or simply using the latest backup to restore the data to the corrupted database.

2.1.3 Media Failure:

A media failure is a physical problem with the drive, it can cause write or read failures to

and from disk files which are required for database operations. Database file are vulnerable in the event of a media failure.

2.1.4 Application Error:

Software often malfunctions which can corrupt data block.

2.2 Backup and Recovery

Oracle provides two ways to perform Oracle backup & recovery, Oracle Recovery Manager (RMAN) and User-Managed backup and recovery, we are going to discuss these options of the backup.

2.2.1 User-Managed Backup:

This user-managed backup – sometimes called a hot backup - requires the DBA to place the database's tablespaces into BACKUP mode via the **ALTER DATABASE BEGIN BACKUP;** command. Then we can take a copy of all the tablespace's datafiles. While the datafiles are being backed up, any datafile changes are written to the online redo log. This increases the log writing activity. Finally, the DBA must remember to place the database's tablespaces back online by issuing the **ALTER DATABASE END BACKUP;** command to complete the backup process.

This type of backup is not commonly used and it is not enterprise-grade.

2.2.2 RMAN Backup:

Oracle RMAN (Recovery Manager) is the utility built-into the Oracle database to automate the backup and recovery of data, it was first introduced in Oracle version 8.0

RMAN is the preferred method of backing up Oracle databases for most organizations.

RMAN automates administration of backups and ensures data integrity.

Key features:

- Block-Level Corruption Detection During the backup.
- Parallelization of backup & restore data streams.
- Backup files retention.
- History of Backup operations.
- Backup Sets

- Archived redo logs.

2.2.3 Type of Backup

Consistent Backup	Inconsistent Backup
Database file backed up contains all changes up to the same system change number (SCN)	Database files being backed up do not contain all the changes made at all the SCNs
Restoring a consistent whole database backup without needing recovery because the data is already consistent.	You need to restore additional logs after restoring the database because the data is inconsistent which need recovery.

2.2.4 Backup Levels:

Depending on what needs backing up, RMAN offers several choices, ranging from an entire database to the Controlfile.

Type Of Backup	Details	How to
Entire Database	An entire database is a backup of every datafile in the database, plus the control file, this is the most common type of backup.	RMAN BACKUP DATABASE command

Tablespace	<p>A tablespace backup is a backup of the datafiles that constitute the tablespace. For example, if tablespace veeam contains datafiles 1, 2, and 3, then a backup of tablespace veeam backs up these three datafiles.</p> <p>Tablespace backup is only valid if the database is in ARCHIVELOG mode.</p>	<p>RMAN BACKUP TABLESPACE command</p>
Control File	<p>Control file backup is critical aspect of backup and recovery as database cannot be mount without Controlfile.</p>	<p>RMAN BACKUP CURRENT CONTROLFILE command makes a binary backup of the control file</p>
Archived Redo Log	<p>Archived redo logs are essential for recovering an inconsistent backup, in order to restore from most recent log, every log generated between two points must be available, you cannot recover log 10 to 20 if log 18 is missing.</p>	<p>RMAN BACKUP ARCHIVELOG command or BACKUP ... PLUS ARCHIVELOG command</p>

2.2.5 Recovery Levels:

Depending on what needs recovering, RMAN offers several choices, ranging from the largest restore and recovery operation – an entire database - to the smallest, a single database block.

Type Of Recovery Levels	Details
-------------------------	---------

Entire Database	The entire database can be restored from RMAN backups and then rolled forward to the most recently-available archived redo log, and possibly the most current online redo log (should it still exist). DBA's also often leverage a recent full database backup as the starting point for cloning a production database for testing purpose
Tablespace	<p>A tablespace is a logical container for database objects – tables, indexes, LOB segments, and for the UNDO tablespace and UNDO segments. These objects are physically stored within the tablespace's underlying datafile(s). Depending on the maximum datafile size, it is usual for a tablespace to be comprised of multiple datafiles.</p> <p>Should one of the tablespace's datafiles become lost or damaged, the corresponding tablespace must first be taken offline and its resident objects will be unavailable until datafile recovery is completed. Once the datafile is restored from the most current backup, it is recovered forward using all required archived and online redo logs until all transactions are applied. The datafile is then brought back online and the tablespace can be reactivated for access.</p>
Individual Datafiles	This is probably the most common RMAN recovery situation in emergencies: A single datafile for a tablespace has been lost through corruption or damage of its underlying storage media, or it has been deleted accidentally. This is essentially the same recovery scenario explained immediately previously for an individual tablespace, with special considerations for SYSTEM or UNDO.
Sets of Transactions	As noted above, RMAN operations focus on restoration and recovery of database blocks. As a result, it does not provide any capabilities to restore and recover a single set of transactions. However, if all prerequisites are met, it may be possible to leverage the FLASHBACK TABLE command to rewind a table to a prior point in time as long as certain prerequisites have been met. The FLASHBACK TRANSACTION command set may be employed to roll back and/or recover transactions at an atomic level.

Single Block Media	<p>If only a small number of damaged or corrupted datafile blocks need to be recovered, the RMAN command <code>RECOVER DATAFILE {#} BLOCK {start#} TO {end#}</code> can be used to first restore recent copies of the damaged blocks from the last available RMAN backup and then use archived and online redo log entries to recover the block(s) forward to the current point in time. This process can be simplified by first issuing the <code>VALIDATE DATABASE</code> command to capture a list of all corrupted blocks and then issuing the <code>RECOVER CORRUPTION LIST</code> command.</p>
Control File	<p>Losing all copies of the database's control file is an extremely unlikely situation while the database instance is operating normally, but it is possible due to severe storage corruption or (more likely) human error, such as accidentally deleting the files manually.</p> <p>In this situation, the database instance must first be shut down and restarted in NOMOUNT mode, with only the SPFILE opened, and then a control file copy must be restored from RMAN backups. Only then can the database be mounted to open the restored control file and then eventually brought into OPEN mode.</p>
Server Parameter File (SPFILE)	<p>Losing the database's SPFILE is an equally unlikely scenario. Much like the loss of all control file copies, it is could be due to severe storage corruption or (more likely) human error, such as accidentally editing the binary SPFILE as if it were its predecessor parameter file (PFILE).</p> <p>In this situation, the SPFILE can either be recovered from RMAN backups; it's also sometimes faster to simply recreate the binary SPFILE from a PFILE using the <code>CREATE SPFILE FROM PFILE = {physical file}</code> command. Or, it may be necessary to shut down the database instance before completing the reconstruction or recovery of the SPFILE.</p>

2.2.6 Recovery Options:

An Oracle database can be recovered to either the current point in time or to an earlier point in time if the DBA decides that approach is pertinent. We briefly summarize the difference below

Type Of Recovery	Details
Complete Recovery	Complete recovery means all data has been restored and recovered to the current point in time. To illustrate, let's assume that a tablespace's datafile has been damaged beyond repair or seriously corrupted due to media failure or even simply deleted by accident.

Incomplete Recovery	Conversely, incomplete recovery means that a DBA makes a conscious decision to recover the entire database to a prior PIT – usually because of a specific user request.
Failed Complete Recovery Requires Incomplete Recovery	Finally, in rare cases, sometimes – usually due to not anticipating a single point of failure, unexpected media failure, or an insufficiently robust backup strategy – a complete recovery situation unexpectedly becomes an incomplete recovery operation, and that means data has been irretrievably lost. In this situation an incomplete recovery procedures must be employed and the owners of the data must be informed of the extent of the lost data so it can be reapplied to the database using manual methods.

3.0 Veeam and Oracle RMAN integration

Oracle RMAN provides leading third-party backup vendors such as Veeam, SBT API integration through a media management library, the library contains SBT API functions, and it is linked with the Oracle server library. Oracle calls the SBT API functions to backup or restore to and from media controlled by Veeam.

Veeam Plugin for Oracle RMAN allows RMAN backup data send to Veeam Backup & Replication repositories.

3.1 Veeam & Oracle components involved during the backup:

Veeam Backup & Replication also referred to as “VBR” provides different methods of deployment, by default VBR is installed as an all-in-one deployment model which has all the different roles installed on the single server. This server can be scaled-out if required, we will discuss some key components of the VBR software which are involved during the Veeam and Oracle RMAN backups.

3.1.1 Veeam Backup and Replication Server:

The Veeam Backup & Replication server is the brains of a Veeam backup solution, The VBR server is responsible for co-ordinating all operations including control of the resource allocation, It provides an interface to backup, restore and monitor all backups.

3.1.2 Veeam Backup Repository Server:

Veeam Backup Repository server is responsible for providing the required storage to store the backups.

3.1.3 Veeam Plugin for Oracle RMAN:

Veeam Plugin for Oracle RMAN integrate with Oracle RMAN SBT API to allow RMAN to send backup data to Veeam Repository and restore from it.

3.1.4 Veeam Explorer for Oracle RMAN:

Veeam Explorer for Oracle RMAN is by default installed on Veeam Backup & Replication Server, Veeam Explorer for Oracle RMAN provide the interface to backup administrator to perform the one-click restore of Oracle database from Veeam server.

3.1.5 Oracle Library:

The Oracle library is a schema object, known as the library which calls are made too by SQL for functions and procedures, the Oracle library is responsible for call SBT API for external backup from the Oracle server to the Veeam Repository server.

The **Figure 6** illustrated Oracle database backup flows to Veeam Repository.

1. Oracle RMAN Oracle Library and media management layer connect to the Veeam Plugin for Oracle RMAN.
2. Veeam Plugin for Oracle RMAN connects to Veeam backup & Replication Server and requests resource allocation.

3. Veeam Plugin for Oracle RMAN starts the Veeam Data Mover Agent on Oracle Server.
4. Source Veeam Data Mover Agent connects with target data mover running on Veeam Backup Repository Server and starts to move the backup to the Veeam Repository.

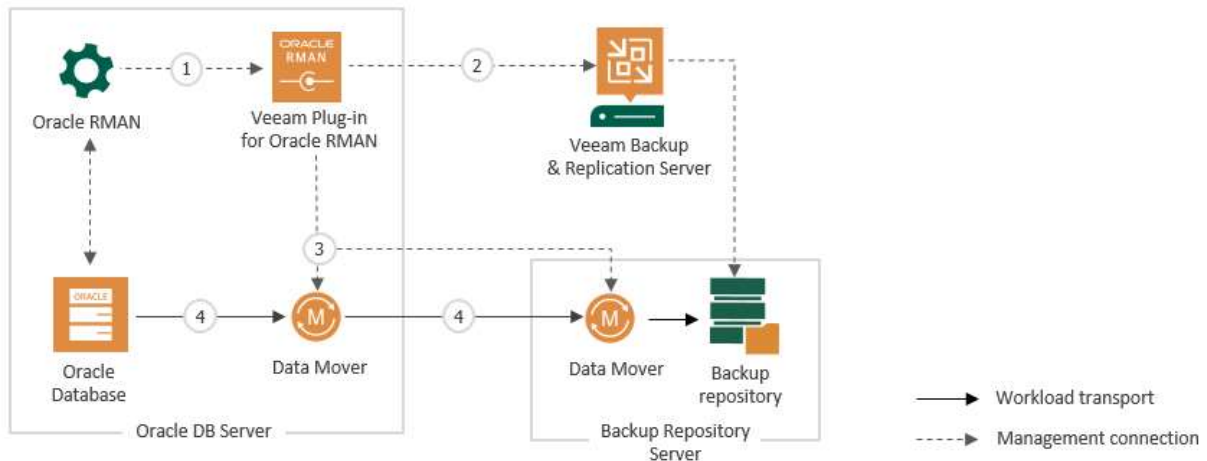


Figure 6: Oracle RMAN & Veeam Backup Flow

4.0 Veeam Plugin for Oracle RMAN Backup Scheduling:

Veeam provides multiple options to schedule the RMAN backup automatically, we will discuss the following options for the automatic backup schedule:

- OS Scheduler
- Veeam Agents for Windows & Linux.

4.1 OS Scheduler:

The RMAN backup scripts can be schedule by using default OS Scheduler available in both Windows and Linux, we will use the following scheduler in our example:

- Crontab Utility.
- Windows Task Scheduler.

4.2 Crontab Utility:

Crontab allows you to script different operations and maintenance tasks in Linux, before we discuss about how to configure RMAN backups let us first understand how crontab is configured and how to schedule the tasks in crontab.

Crontab has 6 fields as seen in **Figure 7**, 1-5 defines the date and time to execute the script and the last field defines the path for the script to be executed.

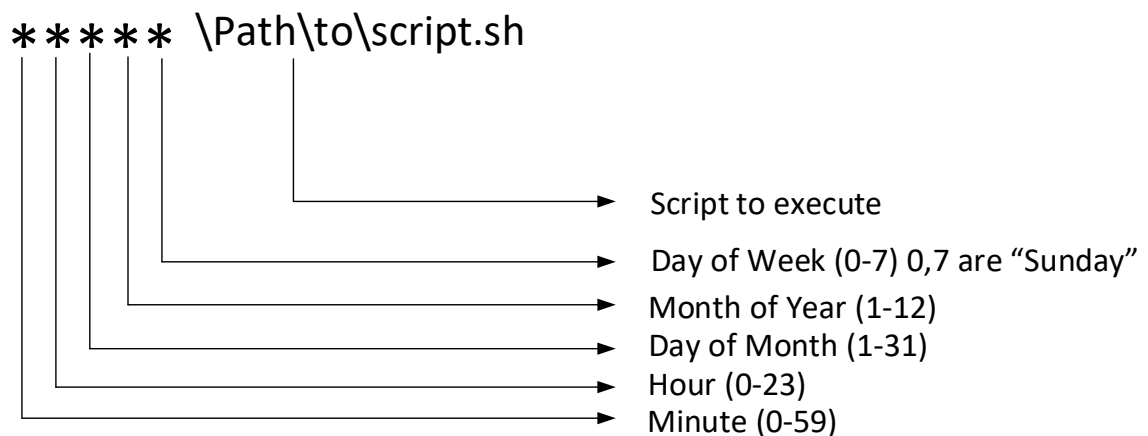


Figure 7 – Crontab configuration

In the example below, we are going to configure crontab to run Oracle RMAN backup every day at 10:00 AM.

1. Run "crontab -e" commands to open crontab editor.
2. Add the line `0 10 *** \pathtoRMANscript\rmanbackup.sh`

4.2.1 Example RMAN script:

```
cat <<EOF > ./rmanbackup.sh
#!/bin/bash
ORACLE_SID=ORCL; export ORACLE_SID
PATH=/usr/sbin:$PATH; export PATH
PATH=$ORACLE_HOME/bin:$PATH; export PATH
LD_LIBRARY_PATH=$ORACLE_HOME/lib:/lib:/usr/lib; export LD_LIBRARY_PATH

RMAN Target /

run
{
backup database plus archivelog;
};

EOF
```

Figure 8: Example RMAN script

4.3 Windows Tasks Scheduler:

Next we will schedule the backup from Windows Task Scheduler for Oracle databases running on a Windows platform.

1. Launch the Task Scheduler from start menu
2. On the right-hand panel, click on Create Task

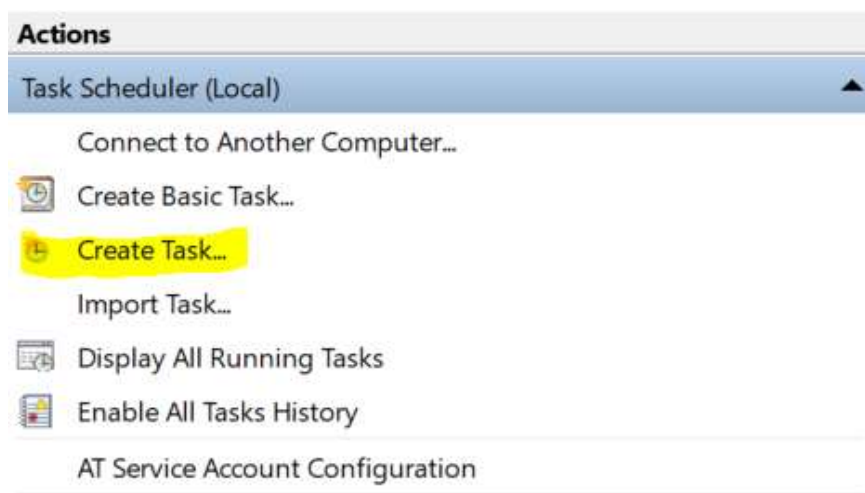


Figure 9 - Windows Task Scheduler

3. Name the task

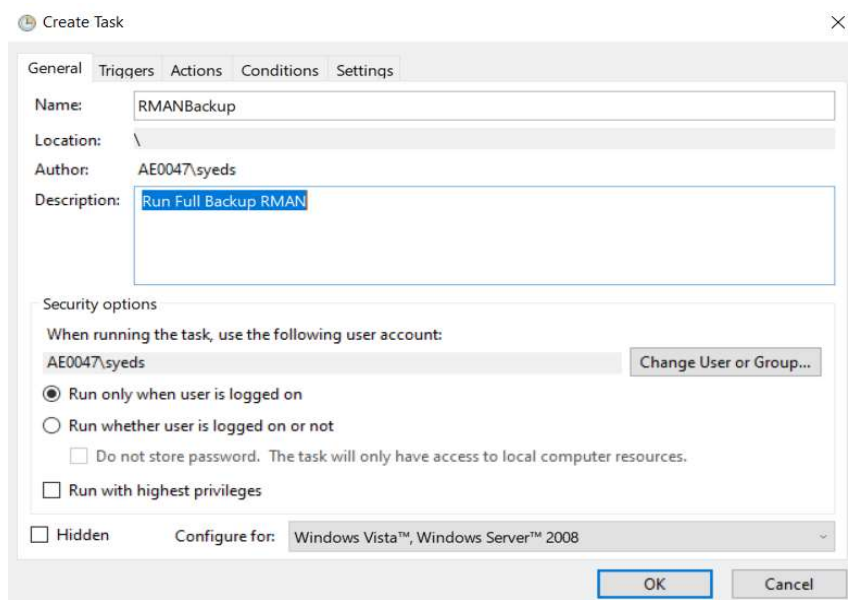
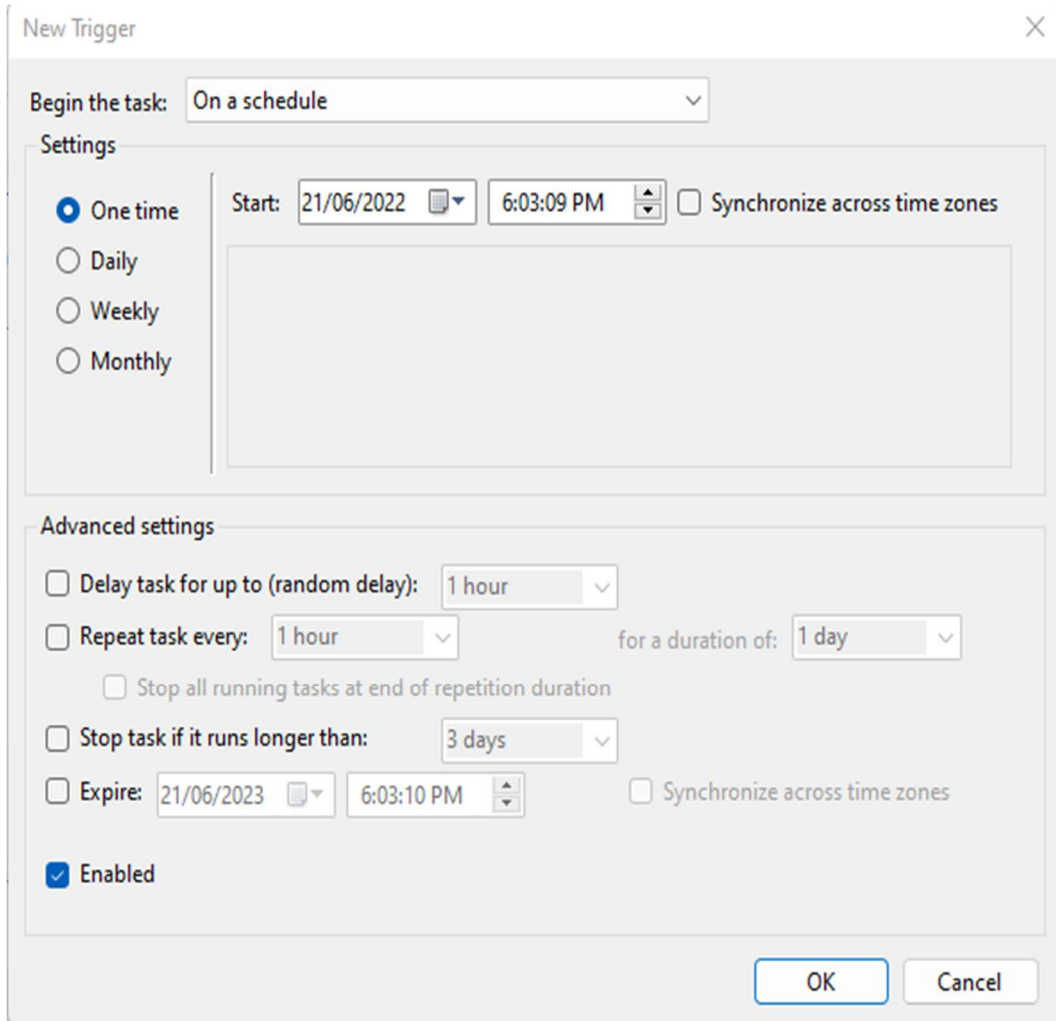


Figure 10 - Task Scheduler General Tab

4. Click on Triggers Tab – Set how often to run the backup shown in figure 11 then Set

Action as start a program and select path to RMAN script



New Trigger

Begin the task: On a schedule

Settings

☒ One time Start: 21/06/2022 6:03:09 PM ☐ Synchronize across time zones

☐ Daily

☐ Weekly

☐ Monthly

Advanced settings

☐ Delay task for up to (random delay): 1 hour

☐ Repeat task every: 1 hour for a duration of: 1 day

☐ Stop all running tasks at end of repetition duration

☐ Stop task if it runs longer than: 3 days

☐ Expire: 21/06/2023 6:03:10 PM ☐ Synchronize across time zones

☒ Enabled

OK Cancel

5. Figure 11 – Set the New trigger

Select time to run the script in the example we are configure the script to run at 1:05 AM every day.

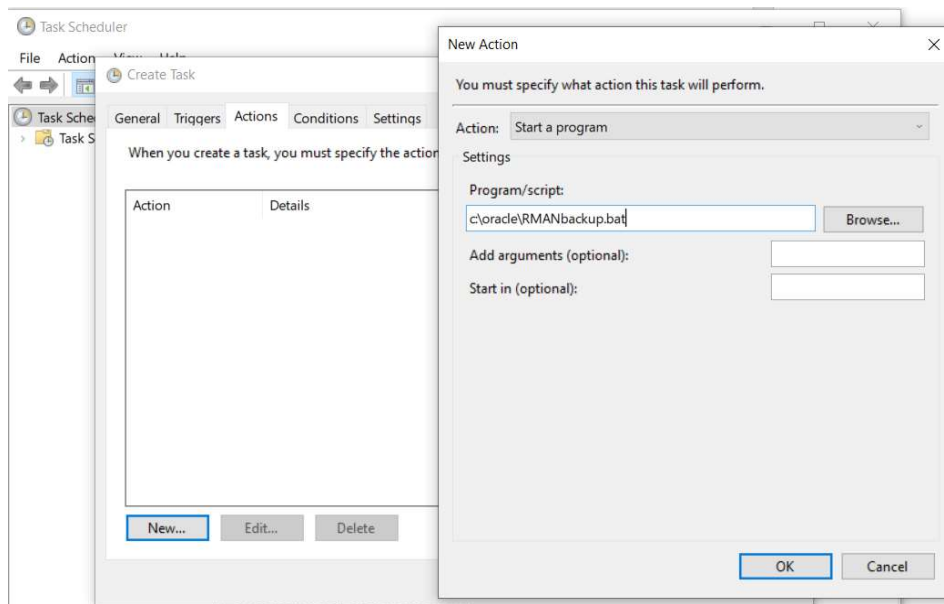


Figure 1.1 - Configure the Action

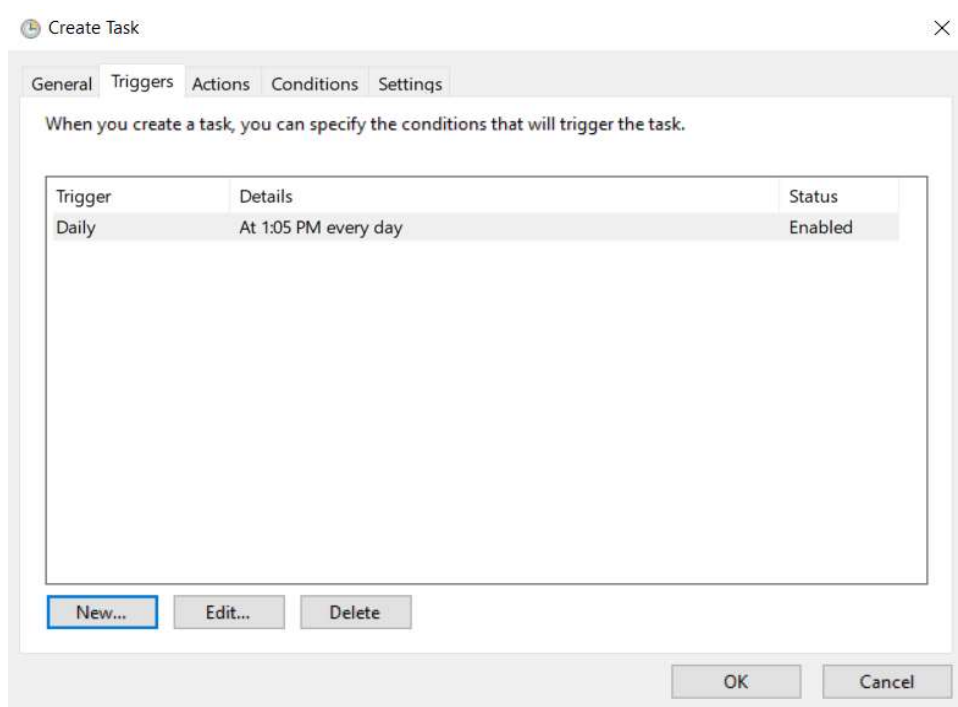


Figure 12 - Windows Task Scheduler Trigger Configuration

This is all about the OS scheduler and scheduling options, next we will discuss the Veeam Agents capabilities to run the script as part of backup job to automatically run the backup jobs.

4.4 Veeam Agents

Veeam agents for Windows and Linux provide you option to run pre and post backup job script you can configure to run any script as pre and post backup job script.

In the example below we will configure the RMAN script in Veeam Agent Backup Job.

1. On the **Home** tab, click **Backup Job** > Windows or Linux as shown in figure 1

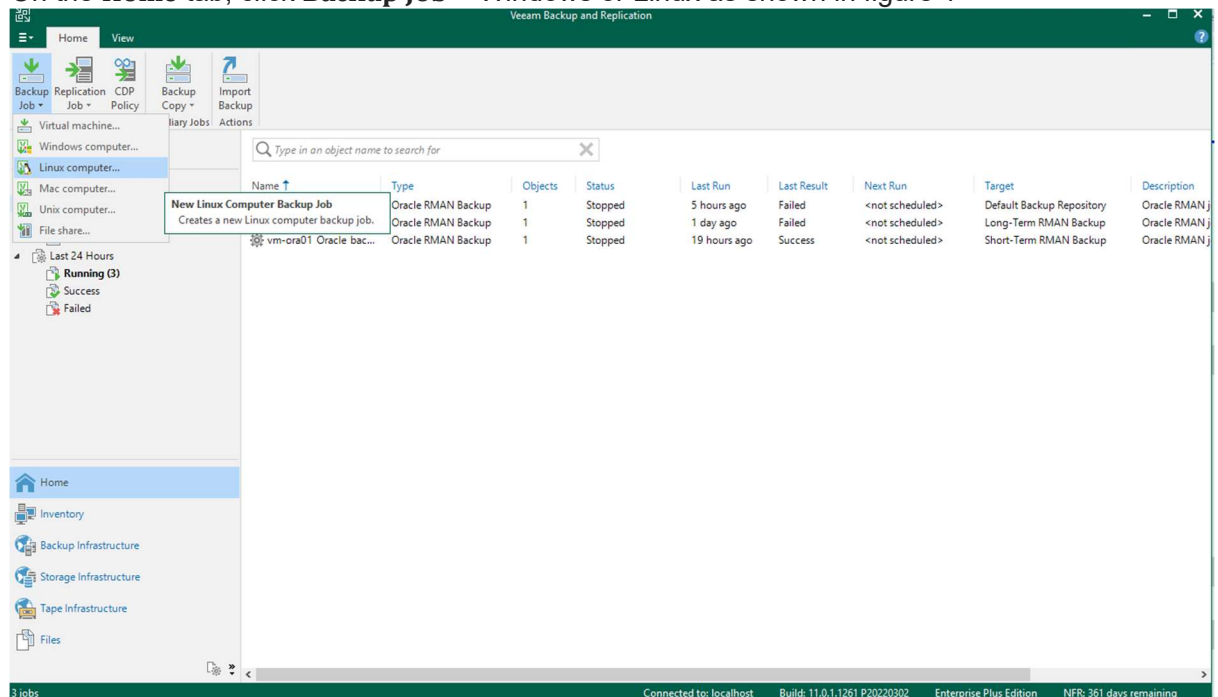
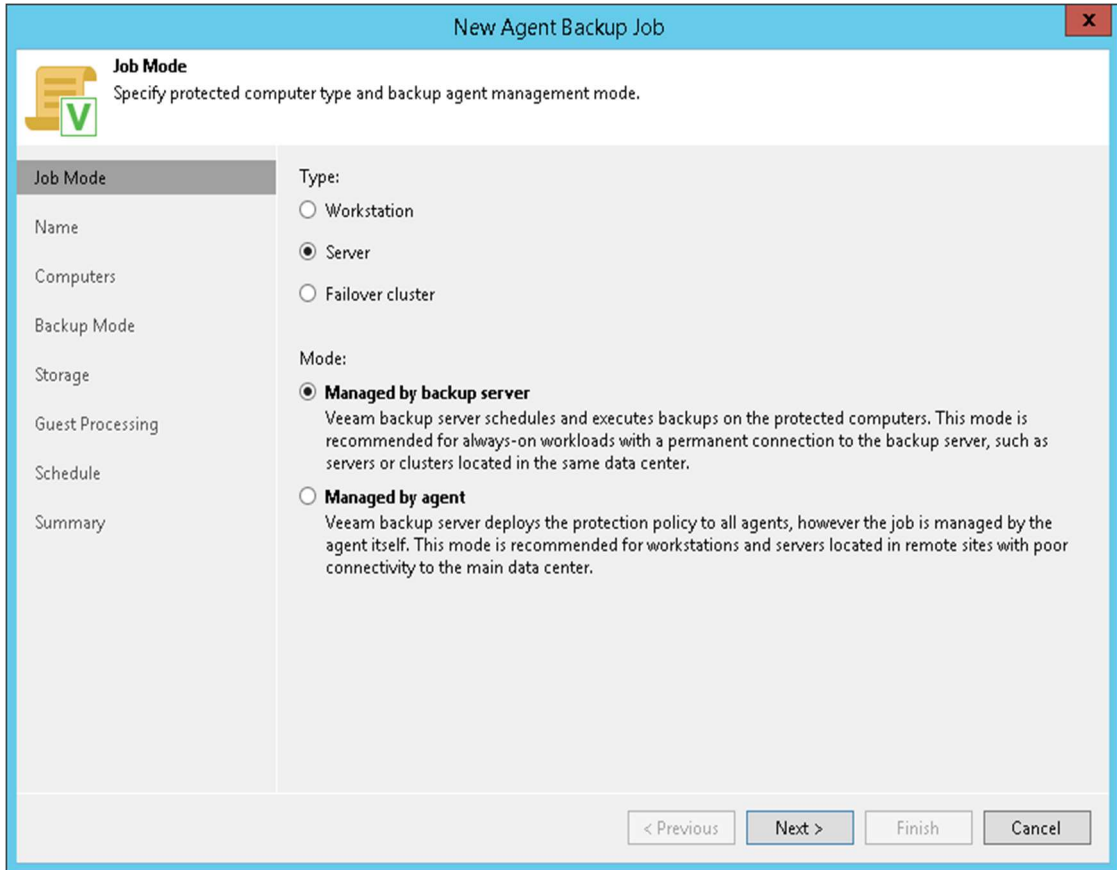


Figure 1 – New Backup Job

2. Select the Job Mode – Server or Workstation – Manage by Backup Server as shown in figure 2



New Agent Backup Job

Job Mode
Specify protected computer type and backup agent management mode.

Job Mode

Name

Computers

Backup Mode

Storage

Guest Processing

Schedule

Summary

Type:

☐ Workstation

☒ Server

☐ Failover cluster

Mode:

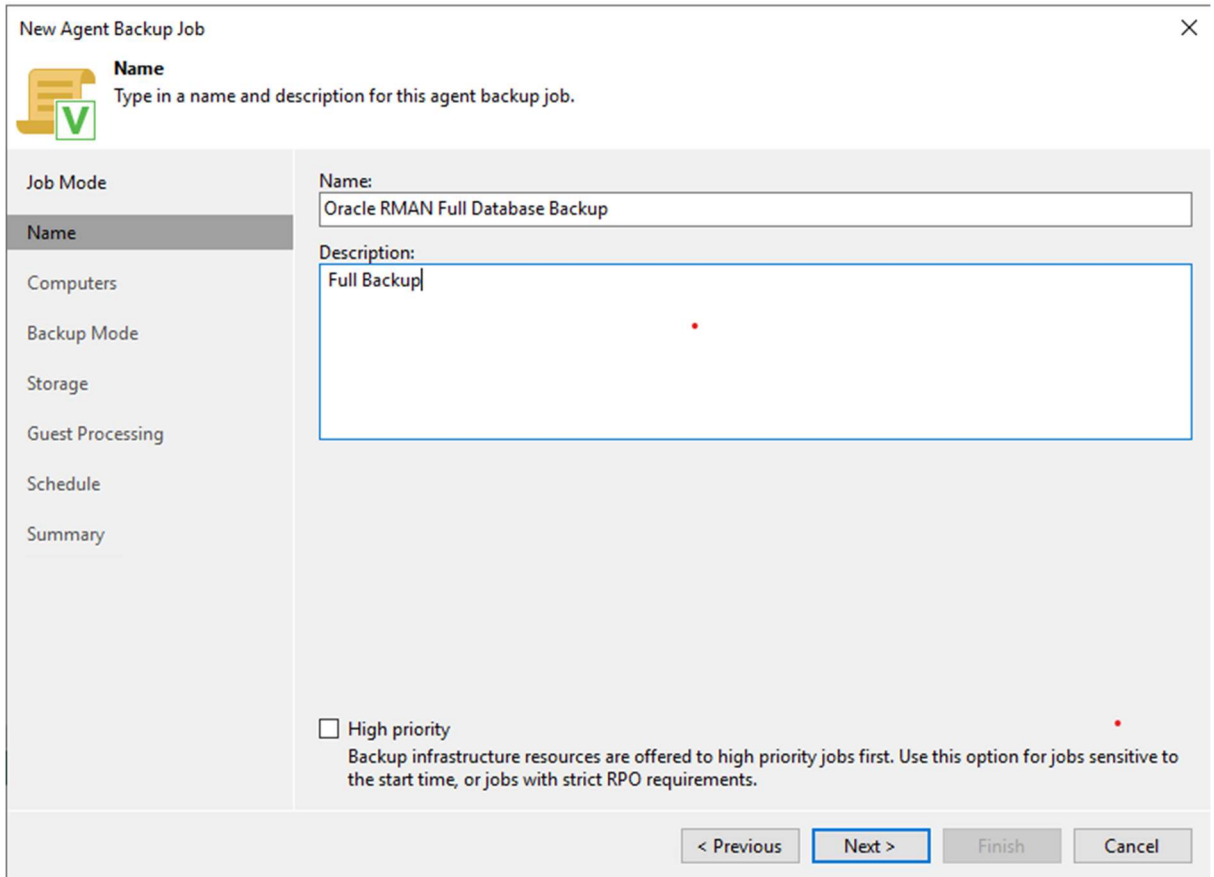
☒ **Managed by backup server**
Veeam backup server schedules and executes backups on the protected computers. This mode is recommended for always-on workloads with a permanent connection to the backup server, such as servers or clusters located in the same data center.

☐ **Managed by agent**
Veeam backup server deploys the protection policy to all agents, however the job is managed by the agent itself. This mode is recommended for workstations and servers located in remote sites with poor connectivity to the main data center.

< Previous **Next >** Finish Cancel

Figure 2 – Job Mode

3. Specify the job name and description as shown in figure 3



New Agent Backup Job

Name
Type in a name and description for this agent backup job.

Job Mode

Name

Computers

Backup Mode

Storage

Guest Processing

Schedule

Summary

Name:
Oracle RMAN Full Database Backup

Description:
Full Backup

☐ High priority
Backup infrastructure resources are offered to high priority jobs first. Use this option for jobs sensitive to the start time, or jobs with strict RPO requirements.

< Previous **Next >** Finish Cancel

Figure 3 – Backup Job Name and Description


4. Select the Computer to Backup – Oracle Database Server as shown in figure 4



Figure 4 – Select the Computers to protect

5. Select backup mode as file level backup – you can simply select any directory to backup i.e. /tmp/ as shown in figure 5 and figure 6

New Agent Backup Job



Backup Mode

Choose what data you want to back up from selected computers.

Job Mode

Name

Computers

Backup Mode

Objects

Storage

Guest Processing

Schedule

Summary

Entire computer

Back up entire computer image for fast recovery on any level. Deleted, temporary and page files are automatically excluded from the image to reduce the backup size.

Volume level backup

Back up images of specified volumes, for example only data volumes. Deleted, temporary and page files are automatically excluded from the image to reduce the backup size.

File level backup (slower)

Back up selected files and directories only. This mode still produces an image-based backup, but only with protected file system objects included in the image.

☒ Backup directly from live file system

Crash-consistent file-level backup without snapshot. Required when backing up from shared folders and file systems not supported by the Veeam snapshot module.

< Previous

Next >

Finish

Cancel

Figure 5 – Select Backup Mode

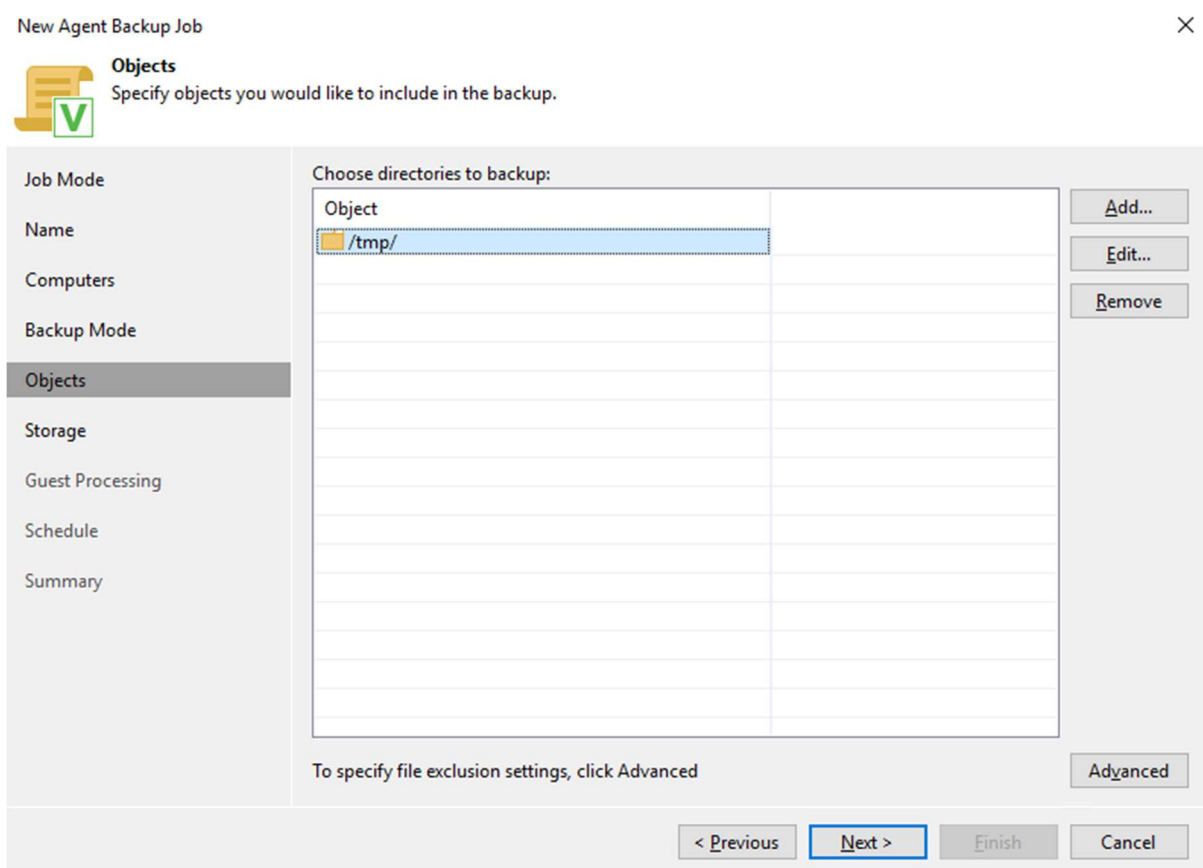


Figure 6 – Select objects to backup

6. Select storage to it can be any repository – select one restore point as we don't want to keep these files as shown in figure 7

New Agent Backup Job ×

Storage
Specify a backup repository to store the backup files produced by the backup job and customize advanced job settings if required.

Job Mode

Name

Computers

Backup Mode

Objects

Storage

Guest Processing

Schedule

Summary

Backup repository:
Default Backup Repository (Created by Veeam Backup) v

118 GB free of 136 GB Map backup

Retention policy: 1 restore points v

☐ Keep certain full backups longer for archival purposes Configure...

GFS retention policy is not configured

☐ Configure secondary destinations for this job
Copy backups produced by this job to another backup repository, or tape. We recommend to make at least one copy of your backups to a different storage device that is located off-site.

Advanced job settings include backup mode, compression and deduplication, block size, notification settings, automated post-job activity and other settings. ⚙️ Advanced

< Previous **Next >** Finish Cancel

Figure 7 – Select storage

7. In guest processing – enable application-aware processing – click on application as shown in figure 8 & figure 9



Figure 8 – Enable Application Aware Processing

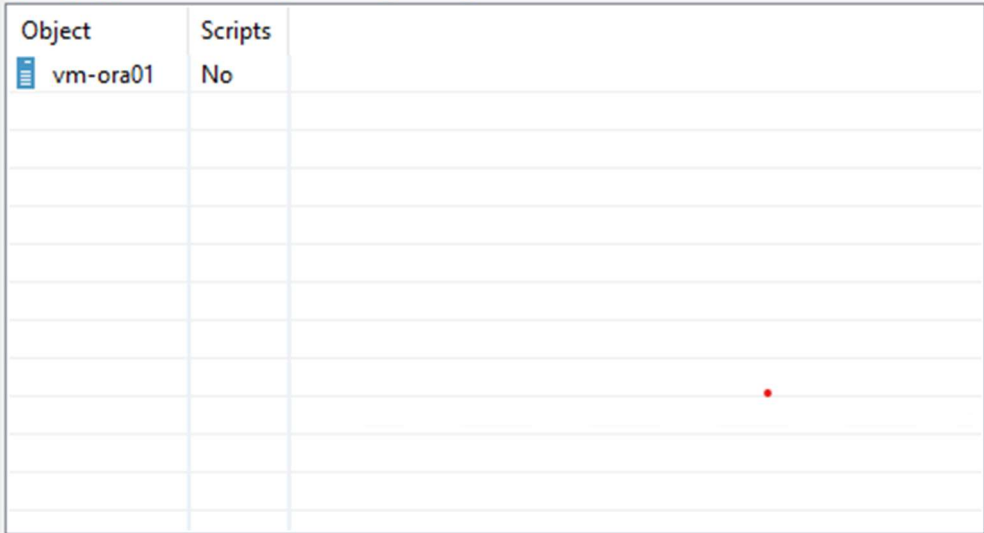


Figure 9 – Edit the object

8. Select the Object, Click Edit – Click on Enable Script and select RMAN backup script

as shown in figure 10, click ok and ok

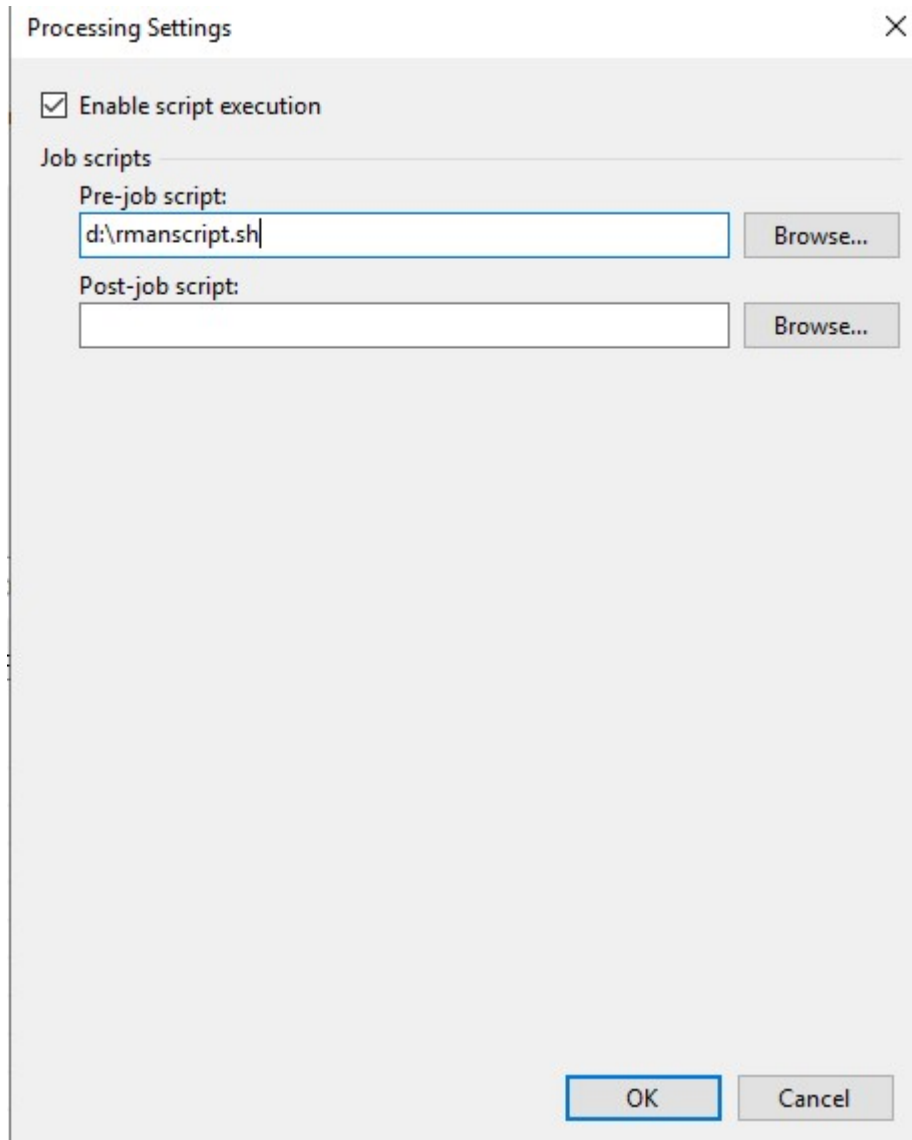


Figure 10 – select the backup script

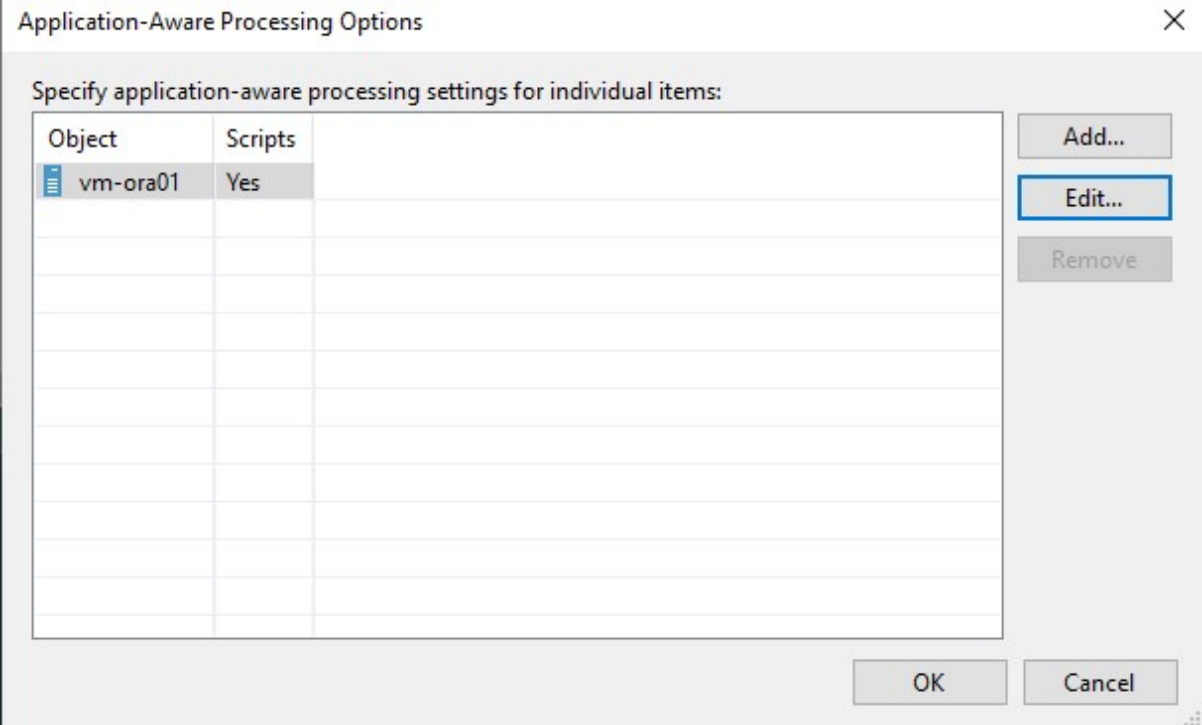


Figure 11 -Application-Aware Processing Options

9. Click Next, Select the desired schedule as shown in figure 12 and click apply.

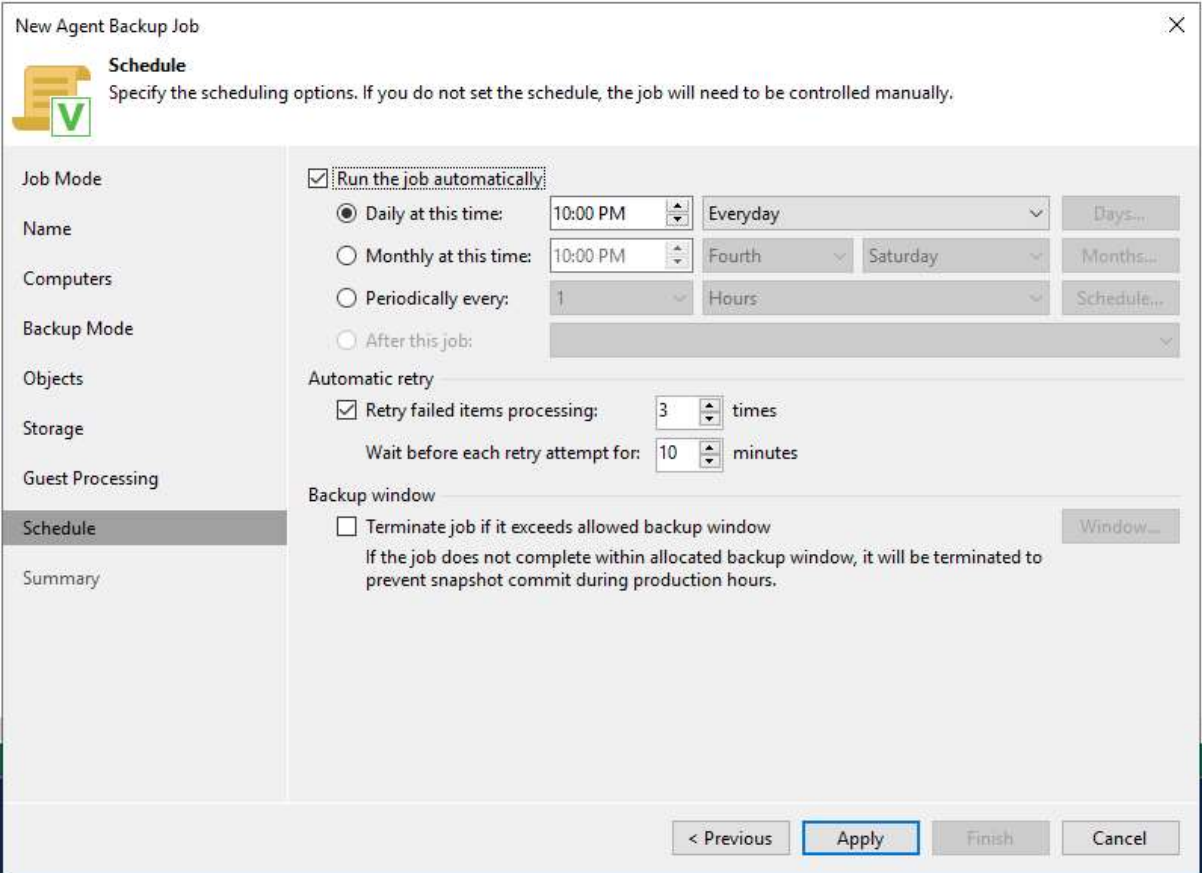


Figure 12 – Select the desired schedule

5.0 Veeam Oracle RMAN retention:

In this section, we will discuss Oracle RMAN retention, Veeam backup copy and possible scenarios where you need to keep different retention policies for different backups.

5.1 Different Retention Policy Options:

In Oracle RMAN we cannot have different retentions policies for different type of backups for example daily, weekly and monthly. Let us discuss a situation where we want to keep a retention policy as follows:

Input	Retention
Daily	30 Days
Weekly	90 Days
Monthly	365 Days

For all the daily backups maintain a normal retention policy:

```
RMAN> CONFIGURE RETENTION POLICY TO RECOVERY WINDOW OF 30 DAYS.
```

As we need to retain the backups for weekly and monthly basis for longer period, therefore we are going to use RMAN “KEEP” option, the KEEP option allows to exempt backup from the RMAN global retention policy.

For weekly backups, we can use the KEEP UNTIL TIME option:

```
BACKUP DATABASE KEEP UNTIL TIME 'sysdate +90';
```

For the monthly backups, we can use the KEEP UNTIL TIME option:

```
BACKUP DATABASE KEEP UNTIL TIME 'sysdate +365';
```

5.2 Veeam Backup Copy:

Veeam relies on Oracle RMAN retention and Oracle RMAN is responsible for managing the retention of all the backups, however; Veeam provides an option to create a copy of Oracle

RMAN backups and keep it for longer period(see figure 1). The purpose of the backup is to provide capability for a longer retention of backups and off-siting of the backup from one storage or physical location to another storage or physical location. You cannot pick and choose which backup sets to keep for a longer retention, for example a full backup of specific date, a backup copy copies all the Oracle RMAN backups which are stored on the Veeam repository.

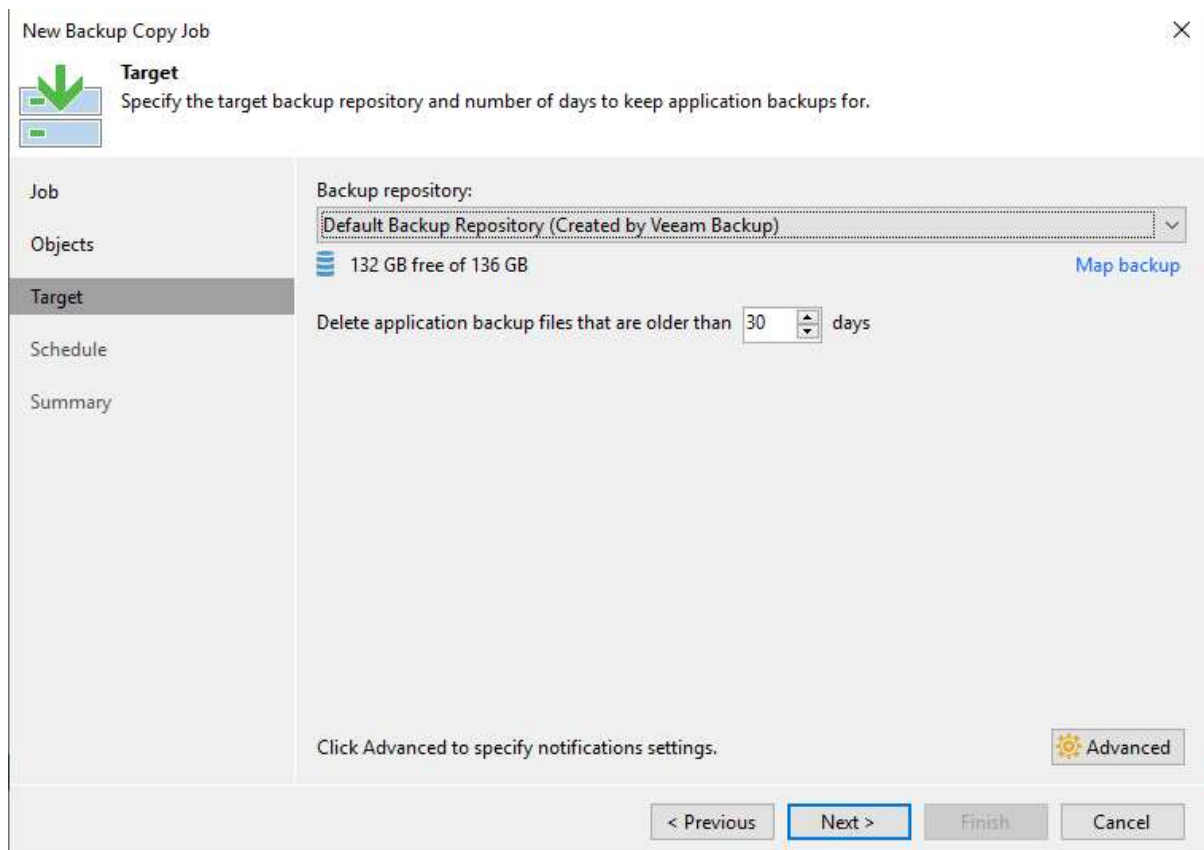


Figure 13 - Veeam Backup Copy Longer Retention Only.

5.3 Leveraging multiple-repository for different retentions:

For a better management of short-term or long-term backup as explained in the section 5.1 Different RMAN retention policy, you can leverage multiple Veeam repositories to store the daily backups in a short-term backup repository and weekly or monthly backups in a long term backup repository.

Veeam allows you to add multiple Veeam repositories as Oracle RMAN backup target storage and it also allows you to specify the repository in channel allocation with a repository id, this is also recommended if you want to copy the weekly and monthly full backups too.

You can also leverage specific backup repositories to keep short-term or long-term backups by using the RMAN manual channel allocation option with a specific repository. This type of configuration allows better management of backups in case we want to copy the specific weekly or monthly full backups to blob storage for longer retention or for normal repository space allocation.

5.4 How to set different retention:

In the example below, we will keep the daily backup on the repository name “Short-Term RMAN Backup and weekly and monthly backups on the repository name “Long-Term RMAN Backup”

1. To find out the repository id:
 - a. Go to veeam installation directory.
 - b. Open the file veeam_config.xml
 - c. Find the line as example below
 - d. For example:

```
<Repository repositoryName="Long-Term RMAN Backup" repositoryID="18741e4f-ccb7-4697-a62d-abb9bfa1fb03" />
```

```
<Repository repositoryName="Short-Term RMAN Backup" repositoryID="e028b089-a62d-42ab-8b02-f73be5e9f5e2" />
```

2. We will use manual channel allocation to specify the repository id of a repository where we desired to keep the daily figure 14 , weekly figure 15 and monthly figure 16 backups:

```
RUN {
  ALLOCATE CHANNEL ch1 DEVICE TYPE SBT_TAPE PARMS
  'SBT_LIBRARY=/opt/veeam/VeeamPluginforOracleRMAN/libOracleRMANPlugin.so'
  FORMAT 'e028b089-a62d-42ab-8b02-f73be5e9f5e2/RMAN_%I_%d_%T_%U.vab';
  BACKUP DATABASE TAG=DAILYBACKUP;
}
```

Figure 14- Daily Backup

```
RUN {
  ALLOCATE CHANNEL ch1 DEVICE TYPE SBT_TAPE PARMS
  'SBT_LIBRARY=/opt/veeam/VeeamPluginforOracleRMAN/libOracleRMANPlugin.so'
  FORMAT '18741e4f-ccb7-4697-a62d-abb9bfa1fb03/RMAN_%I_%d_%T_%U.vab';
  BACKUP DATABASE KEEP UNTIL TIME 'sysdate +90' TAG=WEEKLYFULLBACKUP;}
```

Figure 15-Weekly Backup

```
RUN {
  ALLOCATE CHANNEL ch1 DEVICE TYPE SBT_TAPE PARMS
  'SBT_LIBRARY=/opt/veeam/VeeamPluginforOracleRMAN/libOracleRMANPlugin.so'
  FORMAT '18741e4f-ccb7-4697-a62d-abb9bfa1fb03/RMAN_%I_%d_%T_%U.vab';
  BACKUP DATABASE KEEP UNTIL TIME 'sysdate +365' TAG=YEARLYFULLBACKUP;
}
```

Figure 16-Montly Backup

3. The above command will store the backups as following:

Input	Retention	Veeam Repository
Daily Backup	As per RMAN retention i.e., 30 days	Short-Term RMAN Backup
Weekly Backup	90 days as specify in the command	Long-Term RMAN Backup
Monthly Backup	365 days as specify in the command.	Long-Term RMAN Backup

6.0 Oracle RMAN Backups and Recovery:

Oracle RMAN provides different options to adopt a backup and recovery strategy, by default you can perform the full database backup however; for some large databases performing full database backup every day is not an option, many customers adopt incremental backup as a part of backup strategy to achieve the desired recovery point objective, therefore it is very important to understand the different options and their impact on the recovery time objective.

We are going to explain the Oracle RMAN backup mode first and then we will be going to discuss about different part of Oracle databases which can be protected with Oracle RMAN and Veeam integration.

6.1 Different Backup Mode:

6.1.1 RMAN Full Back up:

In the full backup RMAN takes the backup of all datafiles includes used blocks of datafile, the full backup simplifies the restoration of database, but it takes more time to complete the backup which can impact the performance of highly transactional databases and needs more storage to store the backup.

6.1.2 RMAN Incremental Level 0:

An incremental level 0 backup act as parent backup for subsequent incremental backup, without this backup, you cannot run incremental backups in Oracle RMAN.

To run the incremental level 0 backup:

```
RMAN> backup incremental level 0 database;
```

Advantages:

- Short-restore time.

Disadvantages:

- Additional space required.
- Long backup window required.

6.1.3 RMAN Incremental Level 1:

Incremental Level 1 backup scan the database and take backup of the blocks changed since the most recent incremental level 0 or level 1 or cumulative incremental backup, the restore time objective is higher in incremental backup

Similarly, to run incremental level 1 backup, the command is in figure

```
RMAN> backup incremental level 1 database;
```

Advantages:

- Less disk space required.
- Short backup window required.

Disadvantages:

- Long recovery time as it's required each backup must be applied in succession

The **figure 17** illustrated incremental backup process:

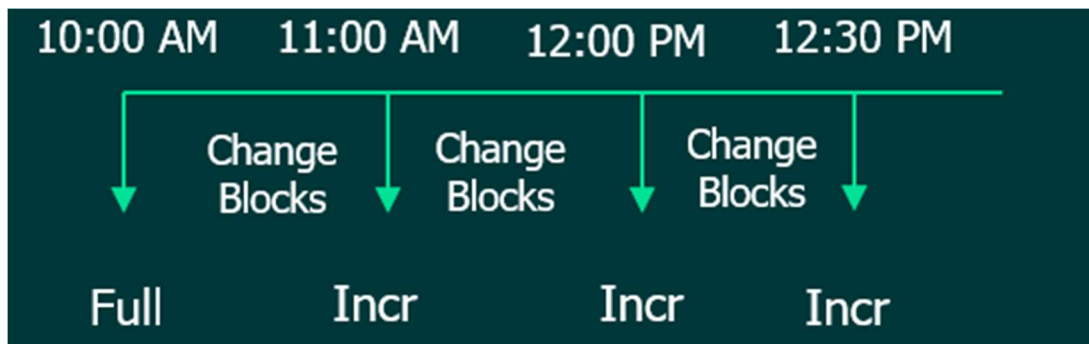


Figure 17 - Incremental Level 1

6.1.4 RMAN Cumulative Backup:

The only different between the incremental level-1 and cumulative backup is a cumulative backup is all the blocks changed after the most recent incremental level-0.

Advantages:

- Short recovery time.

Disadvantages:

- Required more disk space.
- Longer backup window.

The **figure 18** illustrated cumulative backup process:

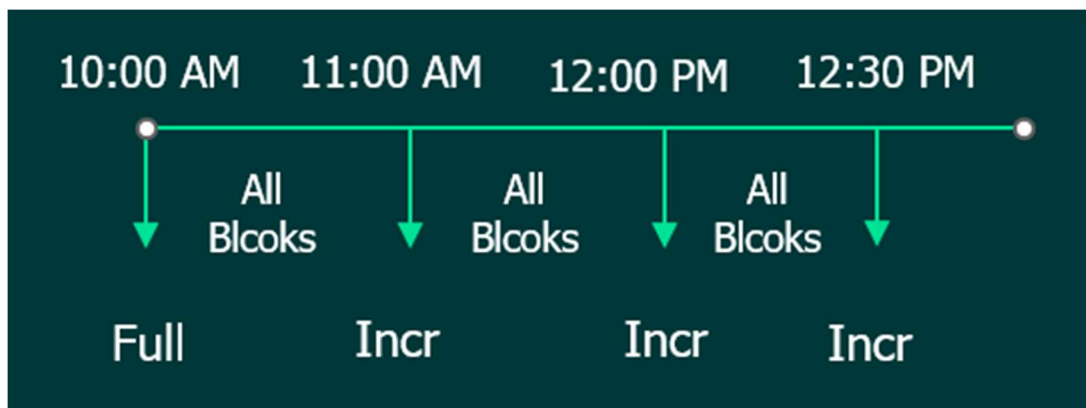


Figure 18 - Cumulative Backup

6.2 Oracle RMAN Compression:

One of the constants for a largest database backup is storage consumption, many databases administrator preferred to take a daily or periodic full backup which can consume a lot of space on the storage, with large space consumption the mobility of backup becomes challenging as well.

Oracle RMAN provides the in-built compression options which you can can advantage of in the backup. the default compression algorithm setting is **BASIC** and does not utilise the Advanced Compression which is included in the Enterprise Edition.

Different compression as described below can be set with simple RMAN commands as shown in figure 19, 20, 21 & 22 with different compression modes applied.

Compression Mode	Default	Backup Size	CPU overhead
Basic	Yes	Small	Very Low
Low	No	Small	Low
Medium	No	Smaller then low	Medium
High	No	Smallest	Very High

RMAN compression is CPU intensive and CPU availability can be a limiting factor.

```
RMAN> CONFIGURE COMPRESSION ALGORITHM 'BASIC';  
RMAN> CONFIGURE DEVICE TYPE sbt BACKUP TYPE TO COMPRESSED BACKUPSET;
```

Figure 19 Oracle RMAN basic compression.

```
RMAN> CONFIGURE COMPRESSION ALGORITHM 'LOW';  
RMAN> CONFIGURE DEVICE TYPE sbt BACKUP TYPE TO COMPRESSED BACKUPSET;
```

Figure 20 Oracle RMAN low compression.

```
RMAN> CONFIGURE COMPRESSION ALGORITHM 'MEDIUM';  
RMAN> CONFIGURE DEVICE TYPE sbt BACKUP TYPE TO COMPRESSED BACKUPSET;
```

Figure 21 Oracle RMAN medium compression.

```
RMAN> CONFIGURE COMPRESSION ALGORITHM 'HIGH';  
RMAN> CONFIGURE DEVICE TYPE sbt BACKUP TYPE TO COMPRESSED BACKUPSET;
```

Figure 22 Oracle RMAN high compression.

6.3 Backup Scenarios

One of the popular features of Veeam Plug-In for Oracle RMAN is that it seamlessly integrates the Veeam Backup & Recovery platform with the Oracle RMAN utility. This allows DBAs to control the backup and recovery processes with a tool that they know and trust.

6.3.1 Full Database Backup

Traditionally, Oracle DBAs have backed up a database instance with one simple command. **Figure 19** implements the BACKUP DATABASE RMAN command to back up the entire contents of the CDB database, including the CDB's separate SYSTEM and UNDO tablespaces, also the ancillary tablespaces that comprise the two PDBs – VEEAM1 and VEEAM2. Note that this command set backs up all archived redo logs as well as the database's control file and SPFILE.

CDB is container database which host many customer-created pluggable databases (PDBs) PDB is a portable collection of schemas, schemas objects and non-schemas object that appears to an Oracle Net Client as a non CDB, All oracle databases before Oracle databas

12c is non-CDBs.

```
RMAN> backup database
```

Figure 19. Backing up complete CDB

A Note on Non-Container Databases vs. CDBs. Oracle databases that predate release 12cR1 does not take advantage of the multitenant infrastructure. As noted, starting with release 21c, Oracle database instances **must** adopt that architecture. However, many of Veeam's customers still employ the non-container (i.e. non-CDB) architecture because they have not yet fully tested their database applications within that multitenant architecture.

It's important to note that the **same** commands used to back up a complete CDB – which includes backing up the SYSTEM, SYSAUX, and UNDO tablespaces shared across all PDBs within the CDB, as well as all of the PDB-specific tablespaces - work *exactly the same* when backing up a non-CDB, and that there is no need to specify any additional parameters when backing up a non-CDB database. Likewise, the process to restore and recover a non-CDB is identical to the process to restore a complete CDB.

A detailed discussion of the myriad features of Oracle multitenant databases is well beyond the limited scope of this white paper. The Oracle 19c [Multitenant Administrator's Guide](#) provides a high-level summary of the key features and differentiators for CDBs and PDBs versus the more traditional non-CDB architecture.

6.3.2 Full PDB Backup

The ability to back up a single PDB from within a CDB is a crucial scenario, especially since most Oracle shops have been encouraged to upgrade their database environments to the Oracle 19c final release that will support both non-CDB and CDB database instances.

Figure 20 backup pluggable database VEEAM1.

```
RMAN> backup pluggable database veeam1;
```

```
Starting backup at 20-JUN-22
using channel ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: starting full datafile backup set
channel ORA_SBT_TAPE_1: specifying datafile(s) in backup set
input datafile file number=00010
name=/u01/app/oracle/oradata/VEEAM/veeam1/sysaux01.dbf
channel ORA_SBT_TAPE_1: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_2: starting full datafile backup set
channel ORA_SBT_TAPE_2: specifying datafile(s) in backup set
input datafile file number=00009
name=/u01/app/oracle/oradata/VEEAM/veeam1/system01.dbf
```

```
channel ORA_SBT_TAPE_2: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_3: starting full datafile backup set
channel ORA_SBT_TAPE_3: specifying datafile(s) in backup set
input datafile file number=00011
name=/u01/app/oracle/oradata/VEEAM/veeam1/undotbs01.dbf
channel ORA_SBT_TAPE_3: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_4: starting full datafile backup set
channel ORA_SBT_TAPE_4: specifying datafile(s) in backup set
input datafile file number=00012
name=/u01/app/oracle/oradata/VEEAM/veeam1/users01.dbf
channel ORA_SBT_TAPE_4: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_1: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2910ii7m_1_1.vab
tag=TAG20220620T231918 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_1: backup set complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_2: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2a10ii7m_1_1.vab
tag=TAG20220620T231918 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_2: backup set complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_3: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2b10ii7m_1_1.vab
tag=TAG20220620T231918 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_3: backup set complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_4: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2c10ii7m_1_1.vab
tag=TAG20220620T231918 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_4: backup set complete, elapsed time: 00:00:15
Finished backup at 20-JUN-22
```

```
Starting Control File and SPFILE Autobackup at 20-JUN-22
piece handle=c-4093942362-20220620-04_RMAN_AUTOBACKUP.vab comment=API
Version 2.0,MMS Version 11.0.1.237
Finished Control File and SPFILE Autobackup at 20-JUN-22
```

Figure 20 - single PDB separately from its CDB

6.3.2 Single Datafile Backup

A rare scenario is to take a backup of a single tablespace. **Figure 21** shows how we backed up the SYSTEM tablespace for the CDB itself.

```
RMAN> backup datafile 1;
```

```
Starting backup at 20-JUN-22
using channel ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: starting full datafile backup set
channel ORA_SBT_TAPE_1: specifying datafile(s) in backup set
```

```
input datafile file number=00001
name=/u01/app/oracle/oradata/VEEAM/system01.dbf
channel ORA_SBT_TAPE_1: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_1: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2e10iej_1_1.vab
tag=TAG20220620T232259 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_1: backup set complete, elapsed time: 00:00:15
Finished backup at 20-JUN-22
```

```
Starting Control File and SPFILE Autobackup at 20-JUN-22
piece handle=c-4093942362-20220620-05_RMAN_AUTOBACKUP.vab comment=API
Version 2.0,MMS Version 11.0.1.237
Finished Control File and SPFILE Autobackup at 20-JUN-22
```

Figure 21 -. Backing up a single database file for a tablespace

6.3.3 Archived Redologs Only Backup

As part of good housekeeping, Oracle DBAs regularly back up archived redo logs to an alternative media type as archived redo logs are required for complete database recovery and then (and only then!) remove these files crucial for complete database recovery from the database's Fast Recovery Area (FRA). We show how to tackle this critical task in **Figure 22**.

```
RMAN> RMAN> backup archivelog all not backed up delete all input;

Starting backup at 20-JUN-22
current log archived
using channel ORA_SBT_TAPE_1
using channel ORA_SBT_TAPE_2
skipping archived logs of thread 1 from sequence 7 to 8; already backed up
channel ORA_SBT_TAPE_1: starting archived log backup set
channel ORA_SBT_TAPE_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=10 RECID=4 STAMP=1107891040
channel ORA_SBT_TAPE_1: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_2: starting archived log backup set
channel ORA_SBT_TAPE_2: specifying archived log(s) in backup set
input archived log thread=1 sequence=12 RECID=6 STAMP=1107904626
channel ORA_SBT_TAPE_2: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_3: starting archived log backup set
channel ORA_SBT_TAPE_3: specifying archived log(s) in backup set
input archived log thread=1 sequence=9 RECID=3 STAMP=1107813293
channel ORA_SBT_TAPE_3: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_4: deleting archived log(s)
archived log file
name=/u01/app/oracle/recovery_area/VEEAM/archivelog/2022_06_19/o1_mf_1_7_k
bz5gold_.arc RECID=1 STAMP=1107811926
archived log file
name=/u01/app/oracle/recovery_area/VEEAM/archivelog/2022_06_19/o1_mf_1_8_k
bz5m30k_.arc RECID=2 STAMP=1107812067
```

```
channel ORA_SBT_TAPE_1: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2110ii3i_1_1.vab
tag=TAG20220620T231706 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_1: backup set complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_1: deleting archived log(s)
archived log file
name=/u01/app/oracle/recovery_area/VEEAM/archivelog/2022_06_20/o1_mf_1_10_
kc1lpzm2_.arc RECID=4 STAMP=1107891040
channel ORA_SBT_TAPE_2: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2210ii3i_1_1.vab
tag=TAG20220620T231706 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_2: backup set complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_1: deleting archived log(s)
archived log file
name=/u01/app/oracle/recovery_area/VEEAM/archivelog/2022_06_20/o1_mf_1_12_
kc1zzl7b_.arc RECID=6 STAMP=1107904626
channel ORA_SBT_TAPE_3: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2310ii3i_1_1.vab
tag=TAG20220620T231706 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_3: backup set complete, elapsed time: 00:00:15
channel ORA_SBT_TAPE_1: deleting archived log(s)
archived log file
name=/u01/app/oracle/recovery_area/VEEAM/archivelog/2022_06_19/o1_mf_1_9_k
bz6sdy_.arc RECID=3 STAMP=1107813293
Finished backup at 20-JUN-22
```

```
Starting Control File and SPFILE Autobackup at 20-JUN-22
piece handle=c-4093942362-20220620-03_RMAN_AUTOBACKUP.vab comment=API
Version 2.0,MMS Version 11.0.1.237
Finished Control File and SPFILE Autobackup at 20-JUN-22
```

Figure 22 - Backing up selected Archived Redo Logs, purging any of them once backup has been successfully taken

6.3.4 Controlfile-Only Backup

Many database migration tasks regularly require a consistent, current image of the database's control file as a starting point, so in **Figure 23** we've taken a backup of our CDB's control file.

```
RMAN> backup current controlfile;
```

```
Starting backup at 20-JUN-22
using channel ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: starting full datafile backup set
channel ORA_SBT_TAPE_1: specifying datafile(s) in backup set
including current control file in backup set
```

```
channel ORA_SBT_TAPE_1: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_1: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_1u10ihu1_1_1.vab
tag=TAG20220620T231429 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_1: backup set complete, elapsed time: 00:00:07
Finished backup at 20-JUN-22
```

```
Starting Control File and SPFILE Autobackup at 20-JUN-22
piece handle=c-4093942362-20220620-02_RMAN_AUTOBACKUP.vab comment=API
Version 2.0,MMS Version 11.0.1.237
Finished Control File and SPFILE Autobackup at 20-JUN-22
```

Figure 23 -. Backing up the CDB's control file

6.3.5 SPFILE / PFILE Only Backup

One final backup scenario: **Figure 24** shows how to take a “safety copy” of the database’s binary server parameter file (SPFILE).

```
RMAN> backup spfile;
```

```
Starting backup at 20-JUN-22
using channel ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: starting full datafile backup set
channel ORA_SBT_TAPE_1: specifying datafile(s) in backup set
including current SPFILE in backup set
channel ORA_SBT_TAPE_1: starting piece 1 at 20-JUN-22
channel ORA_SBT_TAPE_1: finished piece 1 at 20-JUN-22
piece handle=e028b089-a62d-42ab-8b02-
f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_1s10ihrm_1_1.vab
tag=TAG20220620T231253 comment=API Version 2.0,MMS Version 11.0.1.237
channel ORA_SBT_TAPE_1: backup set complete, elapsed time: 00:00:15
Finished backup at 20-JUN-22
```

```
Starting Control File and SPFILE Autobackup at 20-JUN-22
piece handle=c-4093942362-20220620-01_RMAN_AUTOBACKUP.vab comment=API
Version 2.0,MMS Version 11.0.1.237
Finished Control File and SPFILE Autobackup at 20-JUN-22
```

Figure 24 – backup spfile

6.4 Recovery Scenarios

6.4.1 Recovering an Entire Database

As shown in **Figure 25**, we recover the entire CDB and all related PDBs to the current point in time.

```
RMAN> startup mount;
restore database;
recover database;
```



```
alter database open resetlogs;
```

Figure 25 -. Recovering a complete CDB, including all PDBs, to the current point in time

6.4.2 Recovering a Single PDB

A more likely recovery scenario is the recovery of a single PDB while leaving the CDB itself and any other PDBs running. In **Figure 26** we demonstrate how to restore and recover only the **VEEAM1** PDB to the current point in time.

```
RMAN> run {
  RESTORE PLUGGABLE DATABASE VEEAM1;
  RECOVER PLUGGABLE DATABASE VEEAM1;
  ALTER PLUGGABLE DATABASE VEEAM1 OPEN;
}
```

Figure 26 – Recovering an individual PDB to the current point in time

6.4.3 Recovering a Single Datafile

The loss of or damage to a single datafile for a specific tablespace, it is possible that such a failure may occur in rare cases. **Figure 27** shows how to restore and recover a single datafile to the current point in time.

```
run {
  restore datafile 15;
  recover datafile 15;
  ALTER PLUGGABLE DATABASE MINITPCH OPEN;
}
```

Figure 27. Recovering a single datafile to the current point in time

6.4.4 Single Pluggable Database

As more IT shops adopt Oracle's multitenant architecture, they are able to leverage separate PDBs to build out separate evaluation environments for DevOps teams. **Figure 28** illustrates how to restore and recover a single PDB to a prior point in time, effectively resetting it after development or testing efforts.

```
RMAN> run {
  SET UNTIL TIME "to_date('15-June-2022 04:00:00', 'DD-MON-YYYY
HH24:MI:SS')";
  RESTORE PLUGGABLE DATABASE Veeam2;
  RECOVER PLUGGABLE DATABASE Veeam2;
  ALTER PLUGGABLE DATABASE Veeam 2;
}
```

Figure 18. Recovering a single PDB to a prior point-in-time

6.4.5 Single Tablespace

Together with the prior scenario, a DBA may also opt to restore and recover a single tablespace to a prior point in time after development or testing efforts have concluded. We show in **Figure 29** how a DBA might restore and recover a single tablespace for the **VEEAM1** PDB to a prior point in time, effectively resetting it after development or testing efforts.

```
RMAN> run{
  RECOVER TABLESPACE veeam1:users UNTIL TIME
  "TO_DATE('22-JUNE-2022 06:00:00','DD-MON-YYYY HH24:MI:SS')"
  AUXILIARY DESTINATION '/u01/oradata/';
}
```

Figure 29. Recovering a single tablespace to a prior point-in-time

6.4.6 Special Recovery Situations

Finally, we review two special recovery situations that, while quite unlikely, are non-trivial to solve without careful consideration.

6.4.6.1 Recover Lost or Damaged SPFILE

As previously noted, this is an extremely unlikely occurrence in any environment and would likely be the result of human error. We include it here simply to demonstrate the capabilities of the Veeam Plug-in for Oracle RMAN.

```
RMAN> restore spfile to
'/u01/oradata//PARAMETERFILE/spfile.272.1091973629';
```

Figure 30 - Recovering from the loss of the database's SPFILE

6.4.6.2 Recover Lost CONTROLFILE (when all current copies lost)

If best practices have been carefully followed, this should be an extremely rare occurrence in any environment, and incredibly unlikely in a robust enterprise environment like an Exadata DBM. However, we include it here for completeness of demonstrating the capabilities of the Veeam Plug-in for Oracle RMAN.

```
RMAN> restore controlfile;
```

Figure 31 – Recovering from the loss of all current copies of the database's control file

6.5 Veeam Explorer for Oracle RMAN:

Veeam provides the option to restore the Oracle databases with powerful Veeam Explorer for Oracle RMAN which also refer us VEOR. VEOR is the built-in tool within Veeam to provide backup administrators ability to perform the Oracle database restores with the graphic user-interface with a few clicks the database is restored, the tool is ideal for both expert and a user with basic knowledge of Oracle such as backup administrators.

VEOR offers three recovery types as shown in figure, we are going to explain each restore type to you and demonstrate the complete database restore.

6.5.1 Recovery Database to specific point in time:

Select this option if you like to perform the complete database recovery to latest or specify point in time, it is same as Oracle RMAN restore option where you opt to restore and recover the complete database.

6.5.2 Restores Datafile to specific point in time:

Select this option if you would like to perform the datafile restore without applying any log files, it is the same as Oracle RMAN restore specify datafile option

6.5.3 Recover from previously restored datafile:

Select this option if you already recovered the datafile and would like to the apply the log files to the restored datafiles in Oracle RMAN.

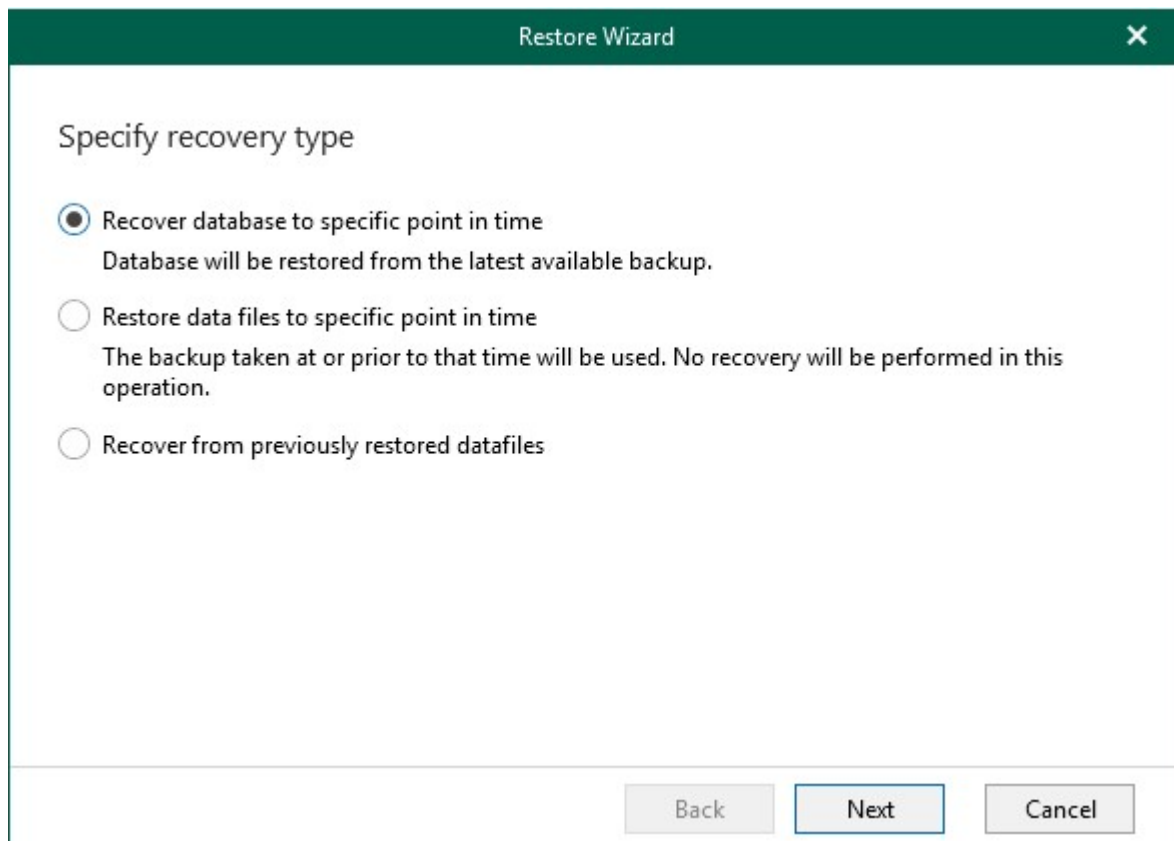


Figure 32 – Specify recovery type

6.5.4 Complete database restores to another server:

This is the frequently used scenarios in a rapid growth environment to test different patches, the DBA often requires the database to restore on a test/dev server. To perform this restore operation with Oracle RMAN the user needs to have the good knowledge of Oracle RMAN. To complete a database restore involves tasks such as creating empty database, configuration of channels to restore the database, set new location for datafile however with Veeam Explorer for Oracle, these tasks can be easily performed by a backup administrator in few clicks it is as easy as having a cup of tea.

We are going to demonstrate the complete database restore from one Oracle server to another Oracle server.

1. Install Veeam Plugin for Oracle RMAN on the target server (where you desired to restore the database) – it's highly recommended to pre-install the Veeam Plugin for Oracle RMAN on all the Oracle database servers which consider candidate for restore in production environment.
2. Open an **RMAN backup**, as described in Exploring RMAN Backups.
3. In the navigation pane, select a **database**.

4. On the **Database** tab, select **Restore Database** > Restore or right-click a **database** and select **Restore** as shown in figure 33

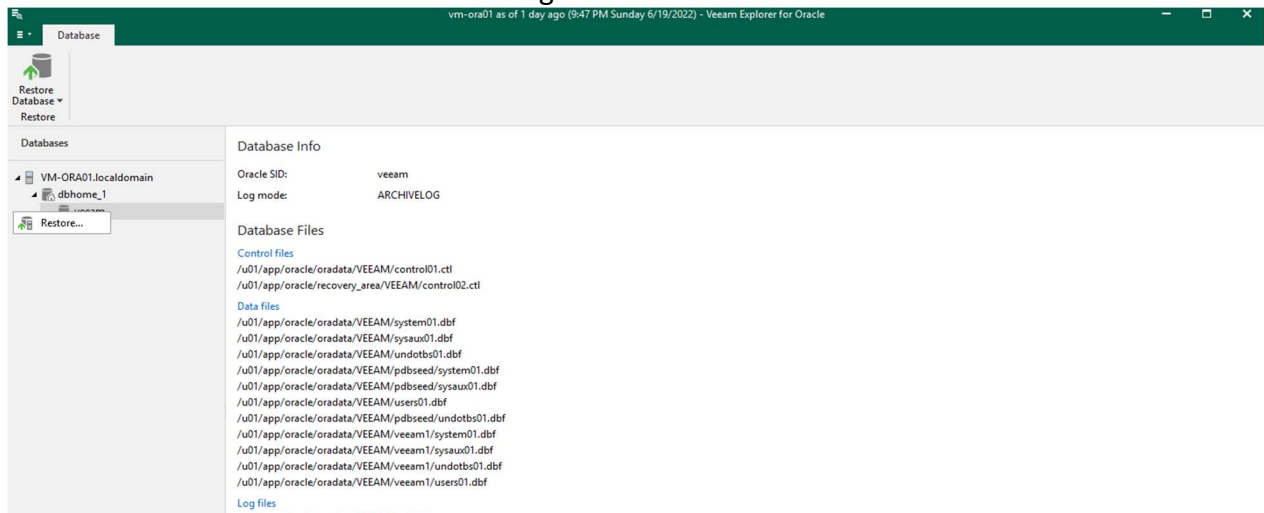
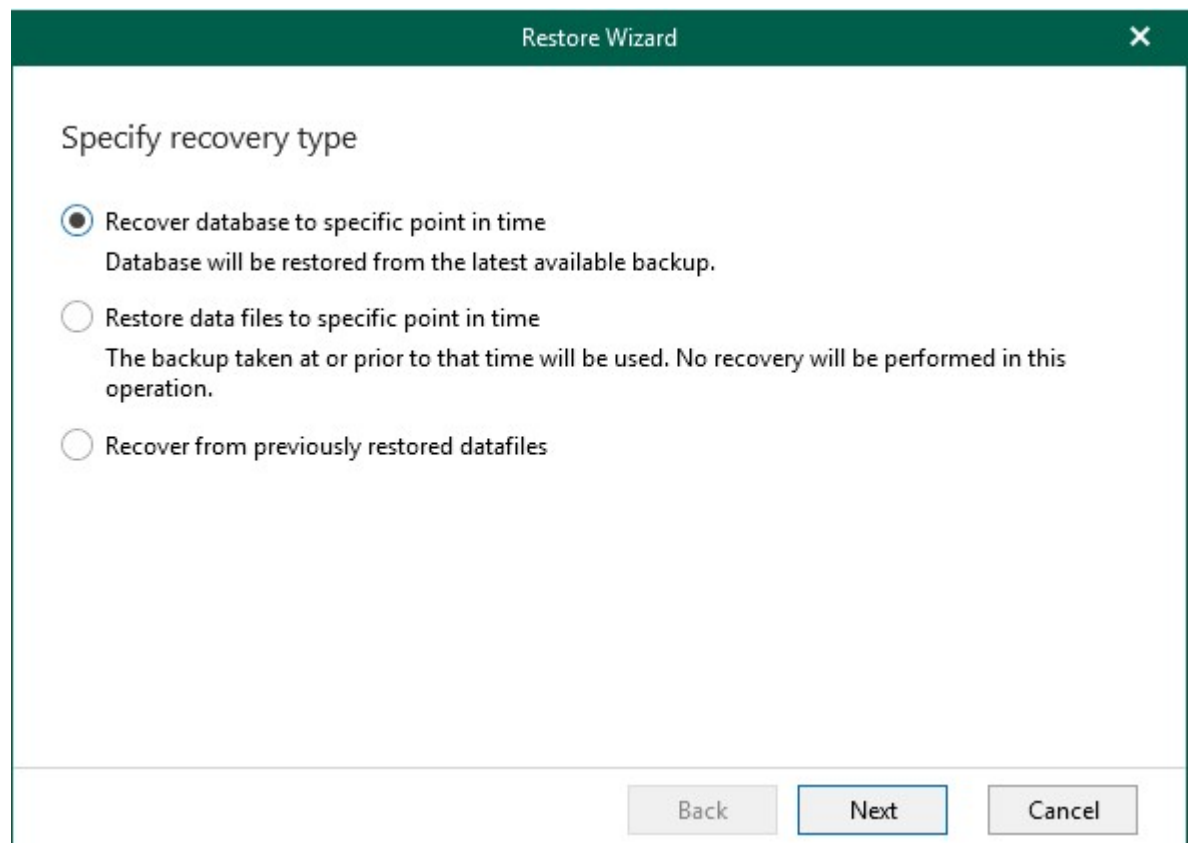
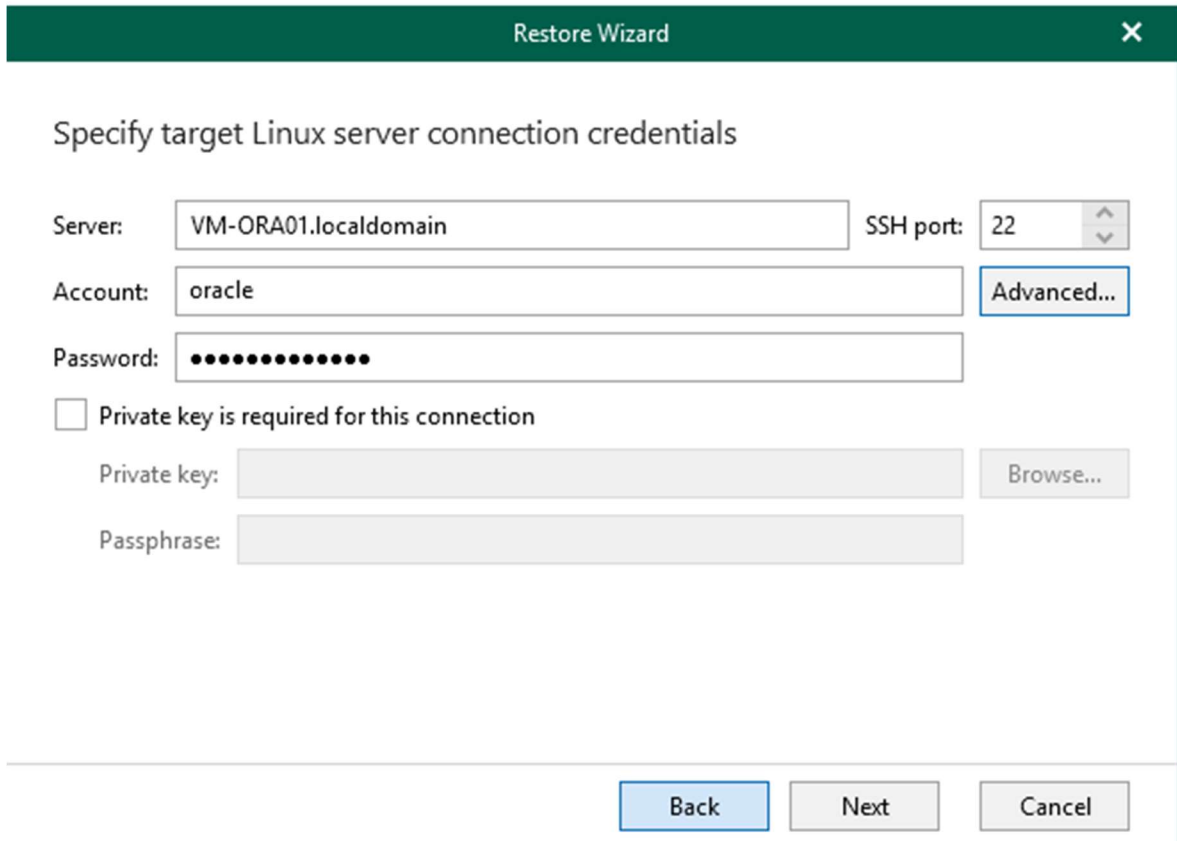


Figure 33 – Veeam Explorer for Oracle RMAN Restore Window

5. Select Recovery type as “Recover Database to Specify Point in Time as shown in figure



6. Specify the server where you desired to perform the database restore along with username and password to access the server as shown in figure 34



Restore Wizard

Specify target Linux server connection credentials

Server: VM-ORA01.localdomain SSH port: 22

Account: oracle Advanced...

Password:

☐ Private key is required for this connection

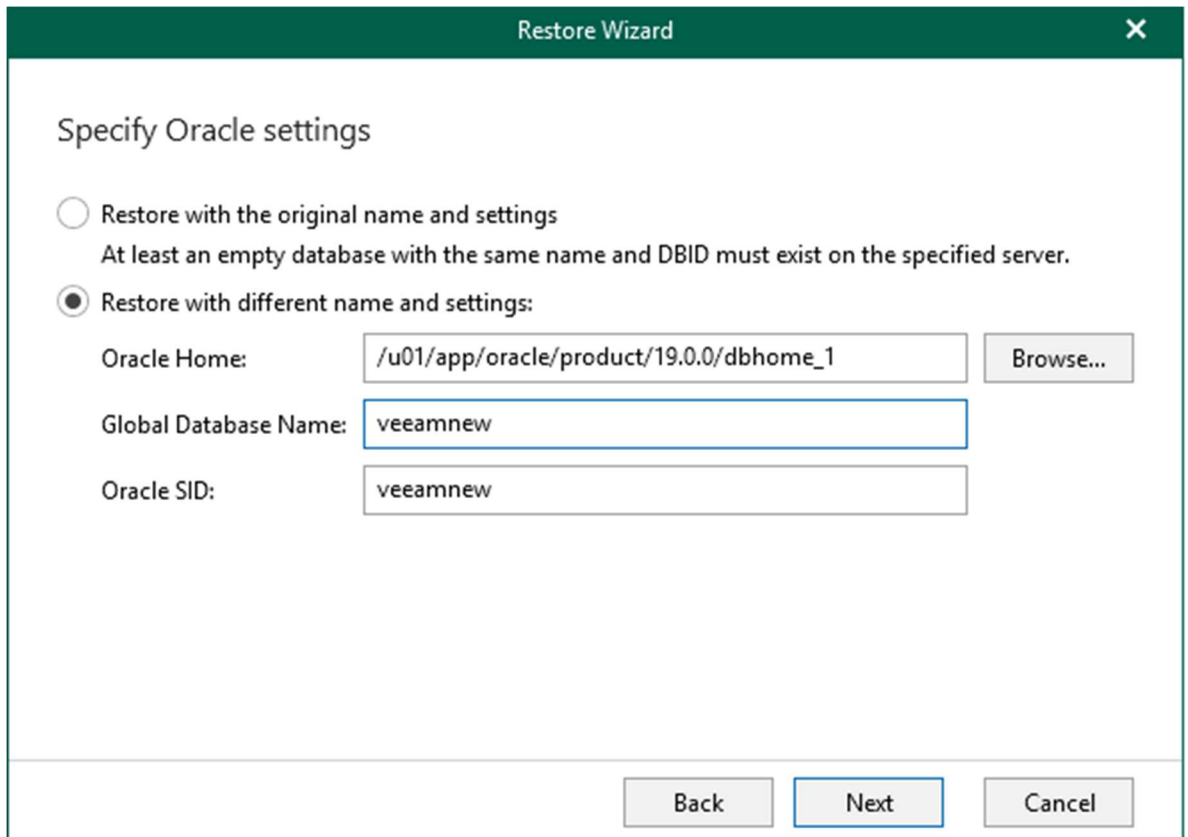
Private key: Browse...

Passphrase:

Back Next Cancel

Figure 34 – Specify Target Server credentials

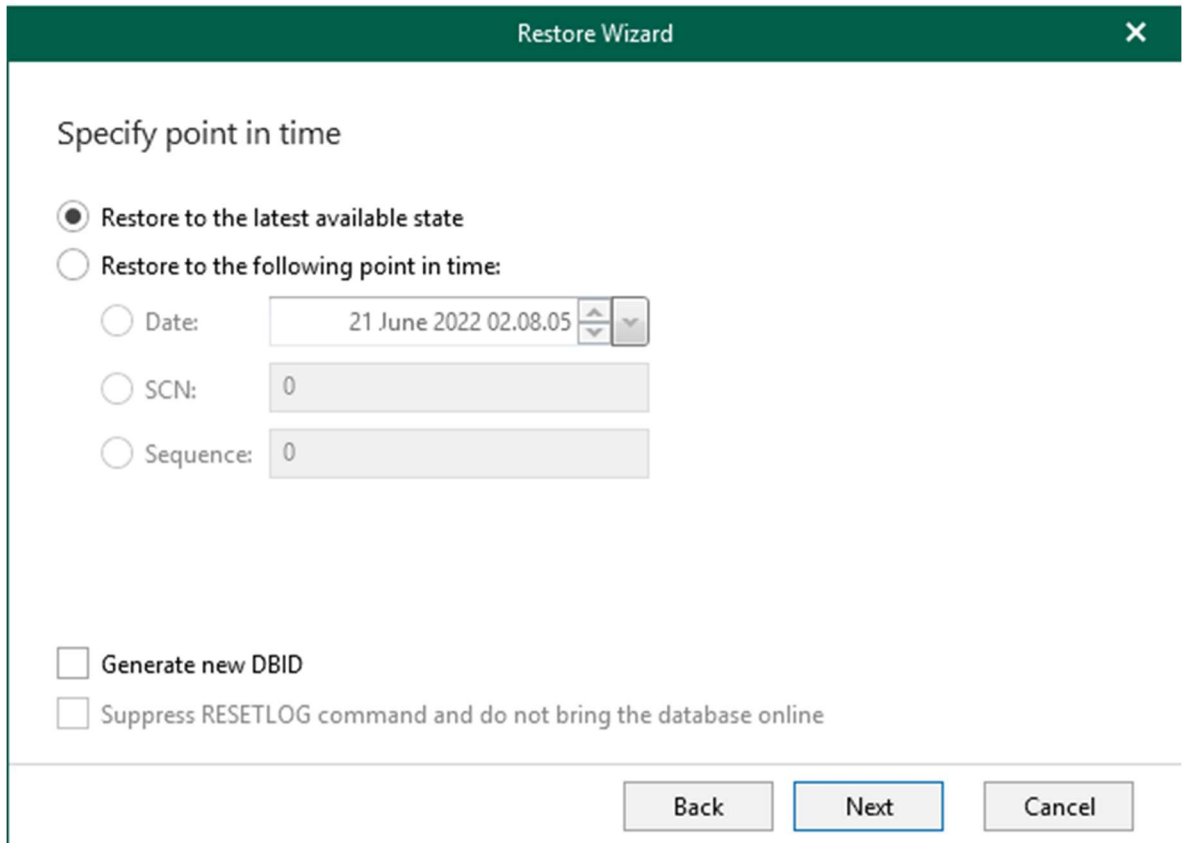
7. Specify Oracle Setting, you can perform the restore with the original name and settings or restore the database with different name and settings, for this demonstration we are going to select different, and settings as shown in figure 35



The screenshot shows a 'Restore Wizard' window with a dark green title bar. The main content area is titled 'Specify Oracle settings'. There are two radio button options: 'Restore with the original name and settings' (unselected) and 'Restore with different name and settings:' (selected). Below the selected option, there are three text input fields: 'Oracle Home:' with the value '/u01/app/oracle/product/19.0.0/dbhome_1' and a 'Browse...' button to its right; 'Global Database Name:' with the value 'veeamnew'; and 'Oracle SID:' with the value 'veeamnew'. At the bottom right, there are three buttons: 'Back', 'Next' (highlighted with a blue border), and 'Cancel'.

Figure 35 – Specify Oracle Settings

8. Specify point in time – You can select the option to restore the database to latest available backup or specify the SCN (System Change Number) or Sequence as restore point, we are going to select latest available backup as shown in figure 36



Restore Wizard

Specify point in time

☒ Restore to the latest available state

☐ Restore to the following point in time:

☐ Date: 21 June 2022 02.08.05

☐ SCN: 0

☐ Sequence: 0

☐ Generate new DBID

☐ Suppress RESETLOG command and do not bring the database online

Back Next Cancel

Figure 36 – Specify point in time

9. Specify Datafiles location – You can specify the new location for datafiles as shown in figure 37 (In case the folders are not available on target server, Veeam will automatically going to create the folders to perform the restore on the specify path) as shown in figure 38

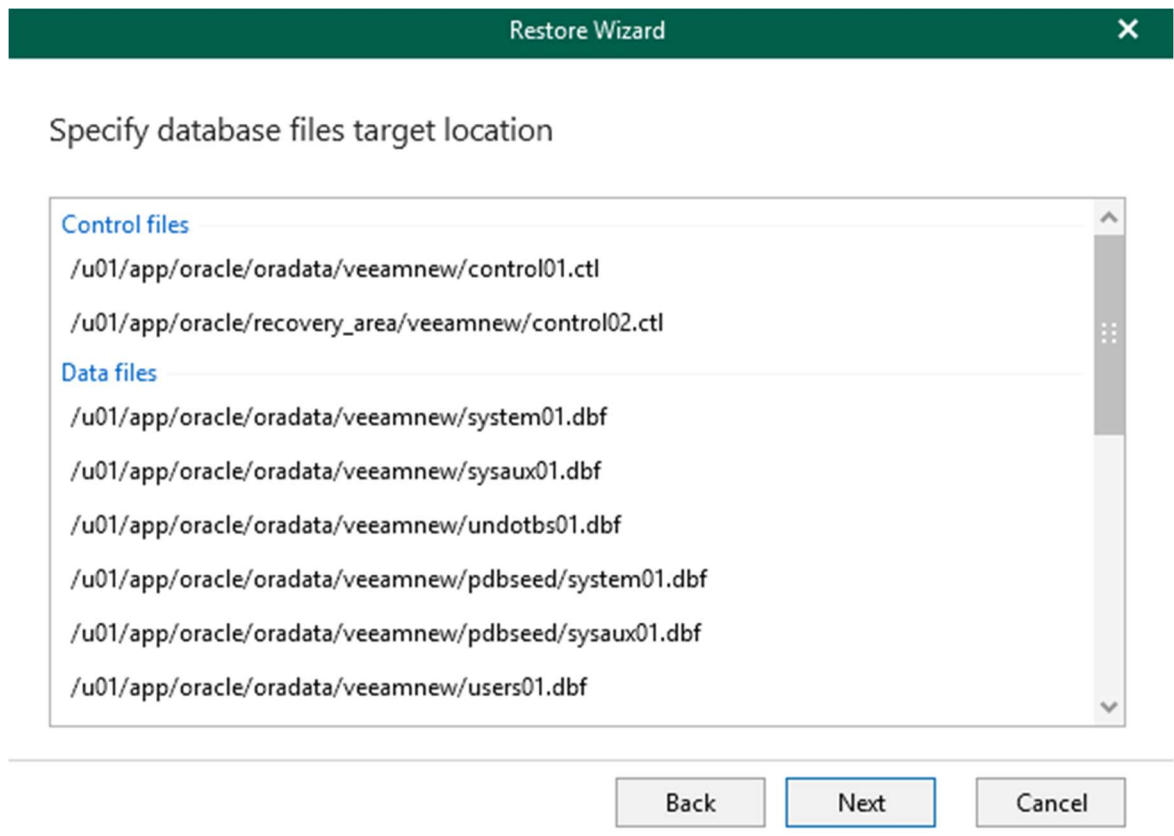


Figure 37 – Specify database files target location

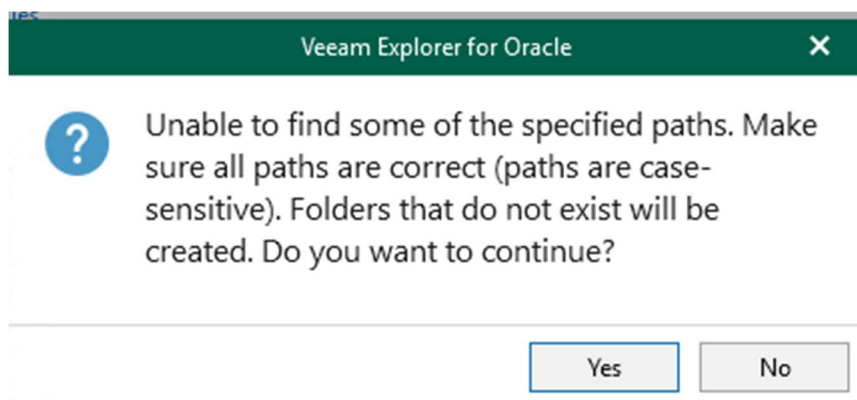


Figure 38 – Folder creation

10. Configure channel allocation – you can use default setting or allocate the number of channels for the restore as shown in figure 39

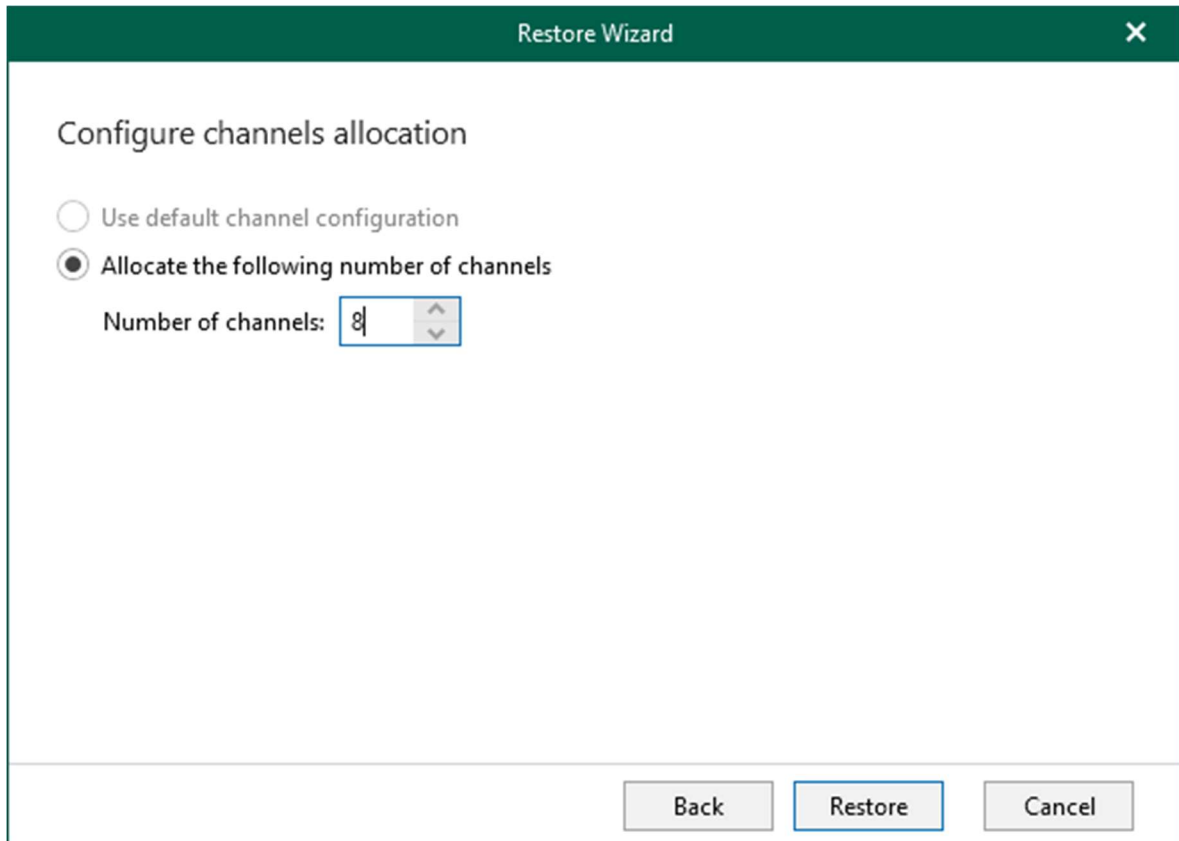


Figure 39 – Configure channels allocation

11. Click restore to start the restore – Veeam will show the restore progress as shown in figure 40

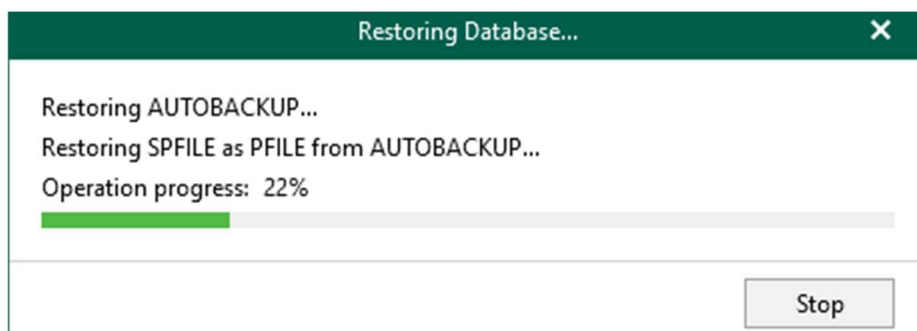


Figure 40 – Database Restore Progress

12. The database has been successfully restored in few click as shown in figure 41

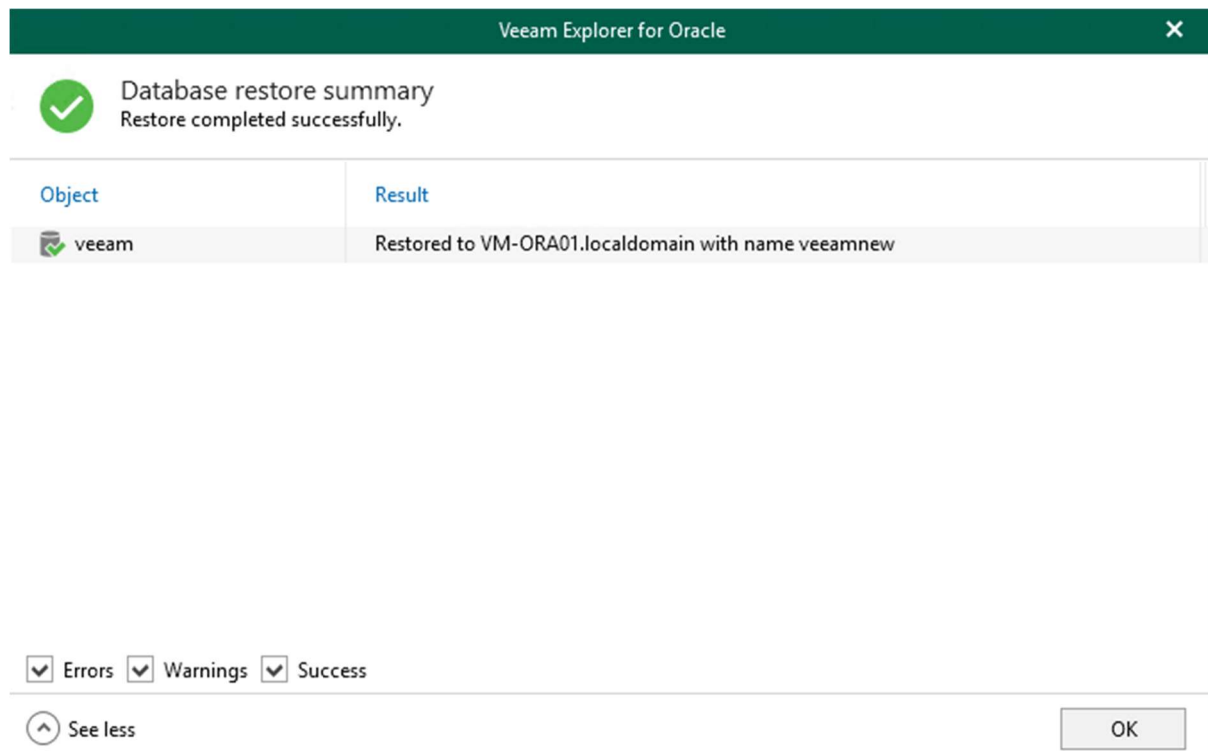


Figure 41 - database restore summary

The above demonstration proves that the complete database restore task can be done in matters of few clicks with Veeam Explorer for Oracle RMAN.

7.0 Veeam and Oracle Backup Sizing:

In this section we will check the Oracle database size and use the SQL statement to find out the Oracle RMAN backup size with and without veeam compression and discuss how to size the Veeam repository server to store the Oracle database backup.

7.1 Oracle RMAN Size & Veeam Compression:

To find out the database size and predict the Oracle RMAN backup size:

1. Run SQL statement to find the datafile size as shown in figure

```
SQL> select sum(bytes)/1024/1024 from v$datafile;
```

```
SUM(BYTES)/1024/1024
-----
                3220
```

Figure 42 – v\$datafile SQL statement

2. Run SQL statement to find the dba_free_space as shown in figure

```
SQL> select sum(bytes)/1024/1024 from dba_free_space;
```

```
SUM(BYTES)/1024/1024
-----
            352.375
```

Figure 43 – dba_free_space SQL statement

3. Subtract the output of v\$datafile – dba_free_space = 2868 MB

As per the sql statement output the backup size should not be higher than 2868 MB, let us now run the backup without compression and with veeam compression to find out the results:

4. We ran the backup with and without veeam compression as shown in figure 44 & 45 :

Database Size	Compression	Backup Size
2868 MB	No – Shown in Figure 44	2664 MB
2868 MB	Veeam compression – Shown in Figure 45	784 MB

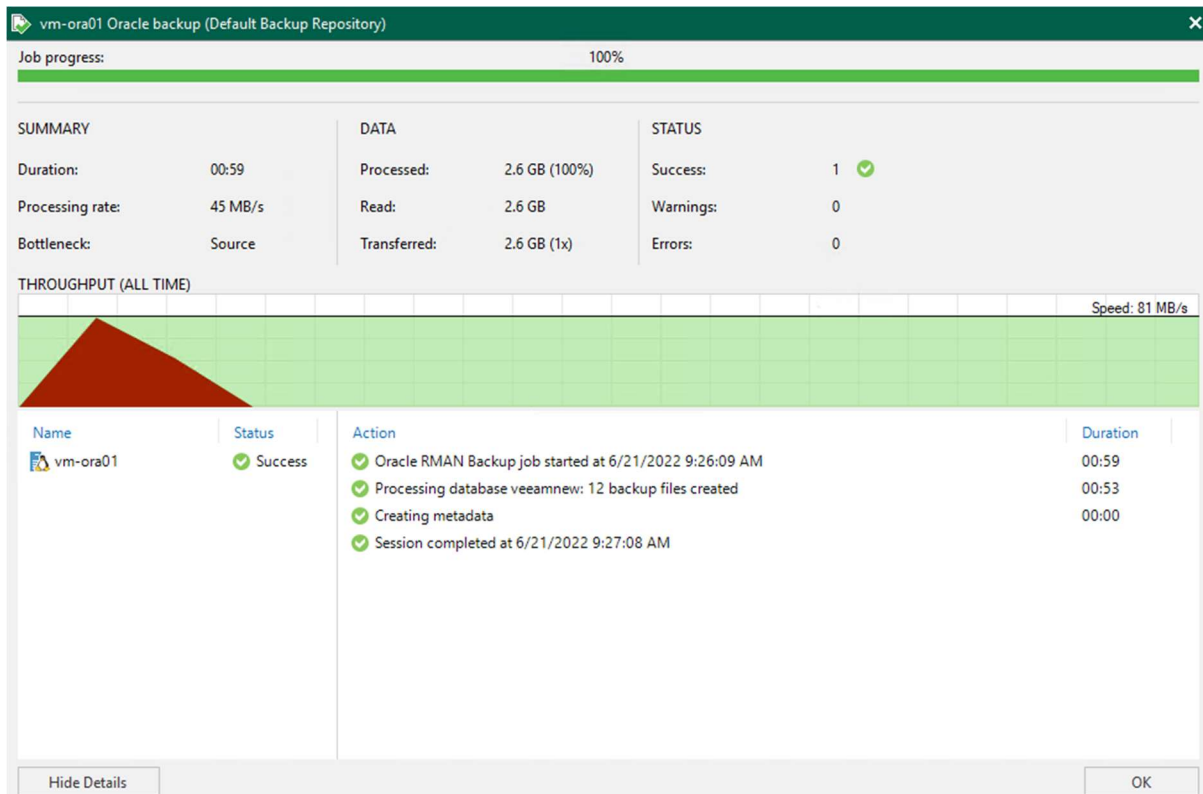


Figure 44 – Database Backup without compression

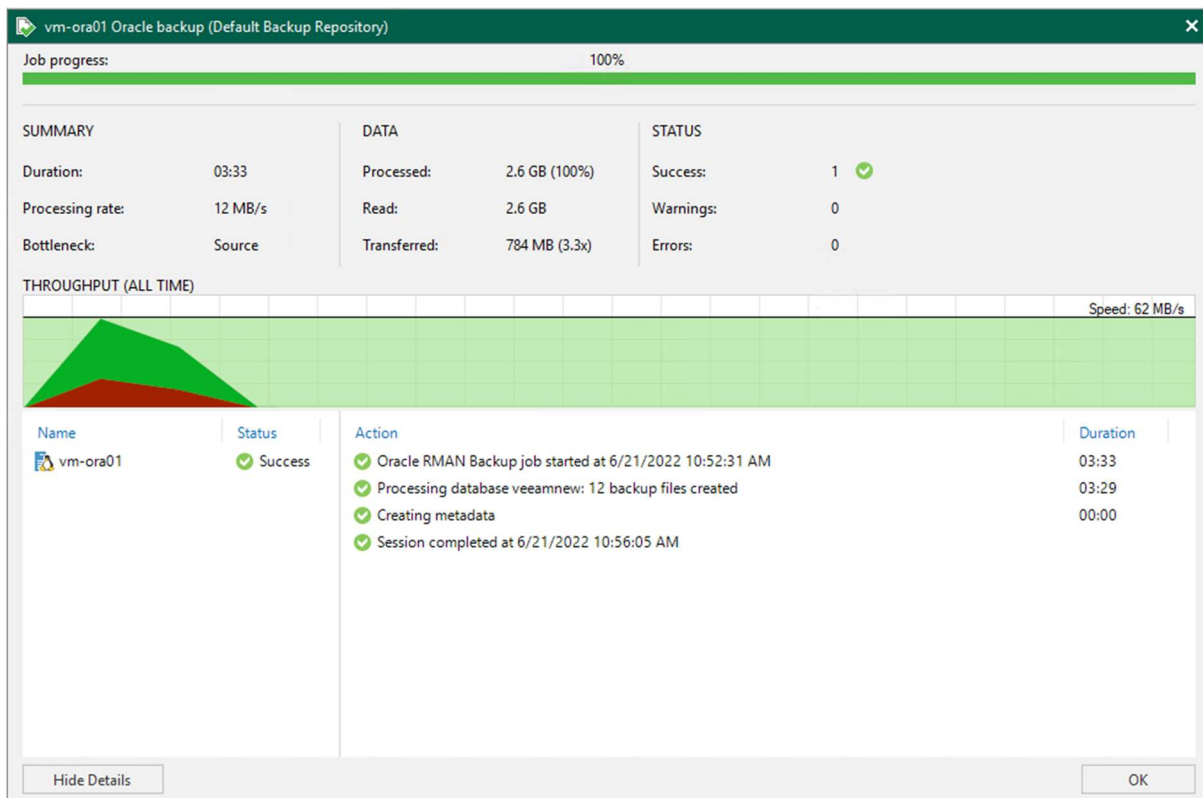


Figure 45 – Database backup with Veeam compression

7.2 Veeam Sizing:

During the Veeam Plugin for Oracle RMAN backup, different components of Veeam are involved during the backup as explained in section 3.0. The Veeam repository server is responsible for storing the Oracle RMAN backup. We can size the repository server based on how many RMAN channels we are planning to use for backup operations.

7.2.1 CPU:

Veeam repository server requires a certain number of CPU cores to process the backup and provides the data stream to Veeam Plugin for Oracle RMAN.

The below is the formula to calculate the required CPU core count for the backup.

$\text{RMAN channels} / 5 = \text{Required CPU Cores}$

For example, for 10 RMAN channels:

$10 \text{ divide } 5 = 2 \text{ CPU Cores}$

7.2.2 Memory:

Similar to the CPU, each CPU core requires memory to provide a data stream to Veeam Plugin for Oracle RMAN.

The below is the formula to calculate the required memory for the CPU Cores:

$\text{Number of CPU cores} * 2.2 \text{ GB} = \text{Required Memory}$

For 2 CPU core we need for example:

$2 \text{ multiple } 2.2 \text{ GB} = 4.4 \text{ GB memory.}$

7.2.3 Storage:

$\text{Number of full backups} * \text{database size} = \text{storage required} - (\text{subtract}) \text{ compression ratio (in the case of compression and to know more about Oracle RMAN compression visit section 6.2)} = \text{required storage} + \text{archive-logs} = \text{required storage space.}$

In case of archive-logs the size of your archive logs depends on the size of your log buffer

and when you make a log switch. To know your log size you have to estimate the volume of DMLS which generate redo info on the database.

8.0 Veeam Plugin for Oracle RMAN & Oracle RMAN Best Practices:

In this section, we will discuss about the best practices for Veeam Plugin and Oracle RMAN, Veeam always promote the 3-2-1-0 rule, this is the golden rule to ensure when disaster strike you have all the tools in place to recovery as fast as possible, we are going to start with 3-2-1 rule and then cover other best practices later in this section.

8.1 The Golden Rule:

3-2-1-0 Rule is the golden rule to evaluate data risk exposure, it's complete guideline on how to protect your mission critical data and consider the worst-case scenarios for disaster recovery and it's also the best practice to adopt for any data protection.

Let's explore what does this golden rule means:

3	There should be copies of data
2	Different media
1	Copy being off site.
0	No errors – verified restore.

Now the million-dollar question is how we can achieve this rule with Veeam Plugin for Oracle RMAN and Oracle RMAN:

Veeam as enterprise grade solution not just offers storage to take backups from Oracle RMAN, Veeam provides the advances option and tools to ensure that data is properly managed.

Option 1:

Veeam allows Oracle RMAN to write data on multiple repositories, this allows you to write the data on multiple physical storages during the backup, in case of the physical storage fails you can always restore any available storage:

Option 2:

Veeam backup copy allows to copy the Oracle RMAN backups to offsite Veeam repository in case the primary Data Center is down, you can use the offsite Disaster Recovery site to restore the database with Veeam Explorer on any available Oracle server, also you can leverage Veeam capacity tier to store the data on the cloud blob storage.

With the options above, Veeam enables the 3-2-1 rule for enterprises to ensure data is available when required.

Next, we are going to discuss the last part of 3-2-1-0 rule strategy, 0 is important the most important factor in 3-2-1-0 rule, no errors in the backup, no surprises during the restore procedure.

Oracle RMAN provides the ability to validate the backup and restore, it's recommended to periodically validate the backups for restore to verify there is no error in the backup files.

Oracle restore validation:

Oracle RMAN validate commands provides many different options to validates the backup operations or restore, we are going to focus on validating the restore to verify the backups for restore operations.

How to validate the database restore

You can simply run this command manually or scripted it to run on periodically to verify the backups are validate for restore, the validate restore command shown in figure below:

RMAN> restore database validate;

Starting restore at 23-JUN-22

using channel ORA_SBT_TAPE_1

channel ORA_SBT_TAPE_1: starting validation of datafile backup set

channel ORA_SBT_TAPE_1: reading from backup piece e028b089-a62d-42ab-8b02-f73be5e9f5e2/RMAN_4093942362_VEEAM_20220619_1j10fs8m_1_1.vab

channel ORA_SBT_TAPE_2: restored backup piece 1

channel ORA_SBT_TAPE_2: validation complete, elapsed time: 00:00:15

channel ORA_SBT_TAPE_2: starting validation of datafile backup set

channel ORA_SBT_TAPE_3: piece handle=e028b089-a62d-42ab-8b02-f73be5e9f5e2/RMAN_4093942362_VEEAM_20220620_2n10iiks_1_1.vab
tag=TAG20220620T232619

channel ORA_SBT_TAPE_3: restored backup piece 1

channel ORA_SBT_TAPE_3: validation complete, elapsed time: 00:00:15

Oracle RMAN provides option to validate database restore on different level and part as

describe:

Input	Command
Validate the backup for restore of spfile	restore spfile validate;
Validate the backup for restore of controlfile	restore control file validate;
Validate the backup for restore of table space veeam	restore tablespace veeam validate;
Validate the backup for restore of controlfile	restore datafile 4 validate;
Validate the backup for restore of archivelog all.	restore archivelog all validate
Validate the backup for restore of entire database.	restore database validate;

With the combination of Veeam Plugin and Oracle RMAN, you can have complete peace of mind as we explained above to have multiple copies of your backup and verified restores.

8.2 Veeam Backup Repository:

It is recommended to use a dedicated backup repository for Oracle RMAN as mixing repositories with other workloads can reduce the overall performance of Oracle RMAN backup and restore.

When using Veeam Backup copy, consider 20% of extra resources on the source repository and limit the available repository tasks on target repository to control the compute, disk i/o and network utilization on the source repository server.

If you are planning to use Veeam Agent to run the Oracle RMAN backup, please consider 1 CPU core for each Veeam Agent Backup Job or use separate repository as Veeam Agent Backup target to avoid exhausting the repository for Oracle RMAN backup.

8.3 Network:

Network plays an important role in the overall backup policy, it is recommended to use a dedicated network for the backup operations, here are some of the recommendations:

Item	Value	Comments
Jumbo Frames	Enable	Veeam Repository and Oracle Servers
Network Speed	Multiple 10 Gbps cards	ideally dedicated layer 2 network for backup operation.

8.3 Deduplication appliance:

It's not recommended to use any compression method either Oracle RMAN compression or Veeam compression when using deduplication appliance as Veeam Backup repository.

If you are not getting desired deduplication ratio on deduplication appliance, you should consider reducing the fileperset to 1 and test the backup.

8.4 Compression:

Always use either Veeam compression or Oracle RMAN compression is not recommended to use both Veeam compression and Oracle RMAN compression if you are using deduplication appliance as target of Veeam Plugin for Oracle RMAN backups, please do not use any compression.

9.0 Advantage of using Veeam Plugin for Oracle RMAN:

Veeam is enterprise grade availability solution which integrated with Oracle Recovery Manager (RMAN) for backup and restore operations, DBAs can perform the backup and restore from the same native console and the backups are being managed by Veeam for data management of Oracle RMAN backup files as we explained in different sections of this paper, to store the backups on multiple locations and restore to any Oracle server, below are the few advantages of using Veeam with Oracle RMAN:

- Veeam plugin is seamless integrate with Oracle RMAN which provide Oracle DBAs ability to perform the backup and restore directly from Oracle RMAN with RMAN native commands.
- Veeam Backup Copy provides the ability to offsite the Oracle RMAN backup to DR site and cloud storage which provides immutable lock to protect the backup files against ransomware and manipulation.
- Veeam Explorer for Oracle RMAN provides the graphic user interface to restore the Oracle databases in few clicks, in case of disaster non-oracle users can provide the restores.
- More productivity for Oracle DBAs as they no longer need to manually write scripts, create directory to restore database for test and development, the database can simply restore with few clicks by backup administrator.
- Simplify licensing, no needs to pay for each feature or database capacity, the single instance license can protect as many databases as you want from single server regardless of their size.

Conclusion:

Thank you for reading this paper, hoping the paper helps understand the key components of Oracle and adopting the best possible disaster recovery strategy with Veeam Plugin for Oracle RMAN and Oracle RMAN.

To summarize the paper covers:

- Oracle Database Key Components.
- Oracle RMAN Backups and restore options.
- Veeam Plugin for Oracle RMAN integration with Oracle RMAN.
- Veeam Plugin for Oracle RMAN & Oracle RMAN retention policies.
- Veeam Explorer restore options.
- Veeam and Oracle Backup Sizing
- Veeam Plugin for Oracle RMAN and Oracle Best Practices.

To know more about Veeam and Oracle RMAN, click on the links below:

- [Veeam Plugin for Oracle RMAN](#)
- [Veeam Backup & Replication Best Practices](#)
- [Oracle RMAN](#)
- [Veeam Explorer for Oracle RMAN](#)