

Mastermind of Oracle Database Backup: Oracle RMAN

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ABSTRACT: RMAN is a feature of Oracle Database product which is used to take backup, restoration and recovering physical files of the Oracle Database (like .dbf, .ctl and so on). With the help of this feature we can easily restore the current session in any of the system, if any of the physical files required to start-up the instance of the Database gets corrupt at any instance or by mistake the user deletes file. It also provides the facility of block level corruption detection during backup and restoration. RMAN communicates with secure backup and clients media management tapes for backups. This research paper gives an idea about the enhancements done in the various versions of Oracle Database. This research paper put a light on the improvements in the Oracle database versions.

KEYWORDS: RMAN, Oracle8i, Oracle9i, Oracle10g, Database, Recovery, Restoration, Backup.

I. INTRODUCTION

RMAN (Recovery Manager) is a backup and recovery tool available in Oracle Databases after Oracle 8 Version. It provides the functionality of database backup, restoration and recovery capabilities providing high availability and disaster recovery concerns. The main concern for the development of RMAN is to check block level or other file corruption during backup and restoration process. It improves the performance and reduces the space consumption while backing up the file.

To get connected to RMAN requires SYSDBA (System Database Administrator) privilege. We can also do incremental backup using Recovery Manager. Incremental backup captures block level changes to the database and also we can perform time based backup in which the Database will automatically takes backup of respective file in time specified by user through EM (Enterprise Manager) or through command line. It provides us the feature of Hot Backup and Cold Backup. Cold backup is done at the time when Database is in a shutdown phase and for Hot backup Database has to be in active state.

II. INTRODUCTION WITH ILLUSTRATION

“Oracle RMAN” is a working of the Recovery manager present in every version of the Oracle product 8 versions onwards.

Why RMAN came into existence?

OR

What is the need for RMAN felt important?

As we know that RMAN is used to take backup of files available in product but prior to version 8 of Oracle database we didn't have any method to overcome human mistakes other to call Oracle Team for the solution but with the help of RMAN now users can take the back up of their files and by any reason it got deleted then customers have the provision to recover the file from the last backup taken of the database.

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How does RMAN work?

When we install Oracle server it gets installed automatically i.e. RMAN is included in Oracle server, no special installation is required for it. When we execute the command for RMAN on command prompt of the operating system, RMAN session starts on client server which creates session for establishing connection with target database. When we execute the RMAN command, it allocates services to perform backup, recovery and restoration process through PL/SQL stored scripts inbuilt in them which are designated to perform the task of backup, recovery and restoration. RMAN stores metadata regarding backup in its recovery catalog which is considered as a pool of information.

III. FEATURES IN ORACLE DATABASE

Basic features of RMAN are listed below:

1. **ASH: ACTIVE SESSION HISTORY** is a collection of data for immediately monitoring every recent Database Activity. It ensures that tables, rows, columns accessed by any user are stored in ASH.
2. **AWR: AUTOMATIC WORKLOAD REPOSITORY** provide database monitoring services for Oracle Database Installations from version 10 and for prior version same functionality of keeping an eye on the Oracle Database installation.
3. **CLUSTERWARE:** Oracle Clusterware is software which allows clustering of various servers so that they can cooperate as a single machine.
4. **DATA GUARD:** It provides high availability capabilities which reduce both planned and unplanned downtime.
5. **GENERIC CONNECTIVITY:** It provides connectivity for both Oracle System and for Non Oracle systems, so that the user having different Database installed with them can interact with the cluster of Oracle servers.
6. **DATA PUMP UTILITIES:** These utilities help in importing and exporting data and metadata among different databases also in different versions. It works in various versions of the product having common extension file, can be easily imported in different version of database.
7. **DRM: DATABASE RESOURCE MANAGER** helps in maintaining resource chart i.e. which execution require the most resources depending upon priority of the user (system admin, system DBA, Normal User, System and many more).
8. **FAST START PARALLEL ROLLBACK:** Oracle Database provides feature of Roll backing the transaction if it is not in commit state and to provide the feature of fast rollback, parallel threads are allotted so that the execution gets faster. Time taken by one thread to perform the task is always greater than task performed by more than one thread.
9. **FGA: FINE GRAINED AUDITING** supplements feature of security by keeping an eye on transaction executed on table/columns on which FGA is enabled. By default FGA is disabled in Database.
10. **FLASHBACK:** This feature inculcates the functionality of data recovery and reconstruction of data. It enables users to flashback the query which they executed mistakenly and executed commit statement.
11. **ODAC: ORACLE DATA ACCESS COMPONENTS**
 - a. ODP.NET (ORACLE Data Provider for .NET)
 - b. ODT (for Visual Studio)
 - c. for ASP.NET
12. **OMF: ORACLE MANAGED FILE** allows automated creation and deletion of Data files.

IV. RMAN FEATURES VERSION 8i

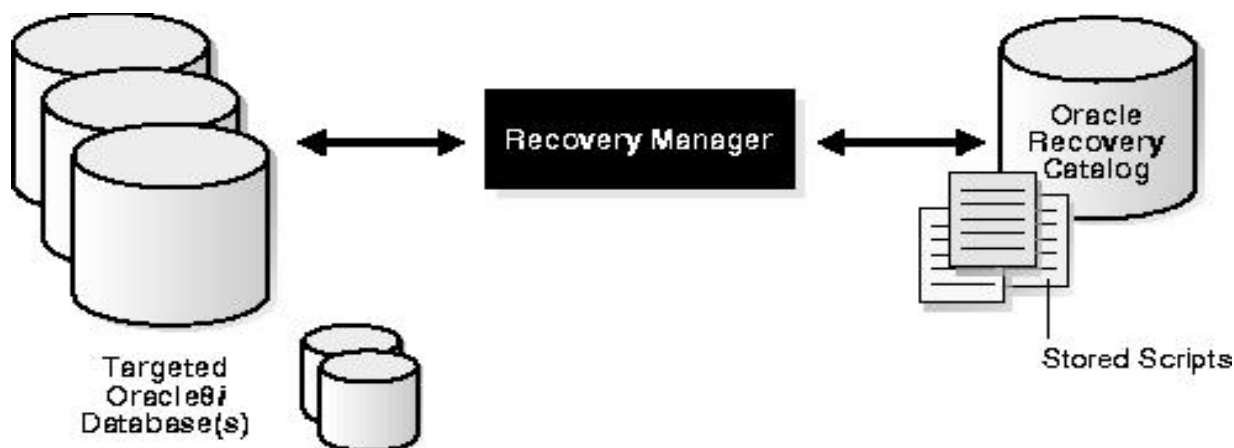
Recovery Manager automates backup, restoration and recovery operations. Various features of RMAN are:-

1. It uses sessions of the server to take backup of table spaces, redo log files, and control files and so on.
2. It compresses backup of data files so that only those data blocks will be backed up on which data is written.
3. It stores at the same time when backup and recovery operations in the script gets executed.

4. It has feature to perform incremental backup so that database can backup those data blocks that have changed since recent backup taken.
5. It helps to duplicate the production database for testing purpose.
6. It uses third party media management software.
7. It generates message log for all backups and recovery operations in readable format.
8. Its uses recovery catalog for both restoration and recovery purpose of the database.
9. It can automatically perform parallelization of backup and recovery operations.
10. It performs crosschecks whether archived data is still present in media management catalog.

V. RECOVERY MANAGER STORED SCRIPTS

A Stored Script is a set of RMAN commands put in braces and stored in recovery catalog. A stored script provide us the power to execute set of commands for backup, recovery and restoration as it minimizes operator errors and improves efficiency and accuracy of the backup.



VI. BACKUP TYPES

RMAN BACKUP HAS BEEN CLASSIFIED INTO VARIOUS TYPES LISTED BELOW:

1. Full or incremental backup

Full Backup: It is a normal backup type in which user takes backup of whole database irrespective to the changes made by user from recent backup taken. It gets scheduled by the Database Administrator because this type of backup takes most of the resources and takes lots of time.

Incremental Backup: It is a special kind of backup which includes only those Data blocks that have changed since last Incremental Backup. Full Backup is not included in this because Incremental backup requires Level 0 incremental backup. Level 0 backup is considered as the base for all incremental backups.

2. Open or Closed backup:

Open Backup: This backup taken at the time when database is in open state. It is also known as "HOT BACKUP".

Closed Backup: This backup is taken when database is in the mount state i.e. not open. These backups can be in consistent or inconsistent state. It is also known as "COLD BACKUP"

3. Consistent or Inconsistent Backup:

Consistent Backup: This backup is taken when database is not in open state i.e. these backups are taken in mounted state and it must not be abruptly closed using ABORT command prior to mounting it for backup. The checkpoint sequence number (SCN no.) must match the header information in the control files.

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Inconsistent Backup: These backups are taken when database is not in mount state i.e. these backups are taken in open state and it must not be abruptly closed using ABORT command prior to mounting it for backup, which will lead to inconsistent backup.

4. **Multilevel incremental backup:**

Each incremental level is assigned with an integral value. Level 0 backup is considered as the base for all incremental backups.

How the Incremental backup works? Every data block in a data file contains a SCN no. During the incremental backup RMAN reads the SCN no (Integral value) of each data block and compares to the checkpoint SCN. If current SCN is greater than the checkpoint SCN of parent then RMAN Backups the block.

VII. DATABASE DE-DUPLICATION

With the help of RMAN we can duplicate our target database for the purpose of testing the database. The RMAN duplicate command allows us to duplicate target database with our original database. The duplicate command takes image copies or backup sets of our target database. It is required in the case where database is open 24*7.

RMAN manages what type of duplication operations?

1. Restores the target databases data files in duplicate database and perform incomplete recovery by using archived redo log files and incremental backups.
2. It generates a new unique identifier for duplicate database due to which it is considered as fresh database.

What restrictions do we have to follow while creating duplicate database?

1. We cannot duplicate offline table spaces but we can add them after duplicating database.
2. If no valid backup of the database exists the command fails.
3. Duplicate the database when target database is not mounted.

VIII. LIMITATIONS OF RMAN 8i

1. With the Oracle 8 standard edition we can allocate only 1 channel at a time which means we first have to DE allocate the channel and further then only we can allocate it to others.
2. The oracle 8 Enterprise Edition can allocate maximum of 4 channels with default MML(Media Management Library) provided on Oracle Media
3. The Oracle 8 standard edition can only allocates 1 channel i.e. if we have operations which require tape and disk channels we have to release and allocate the channels when required.
4. With the full installation of Oracle software of 3rd party limits us to 3rd party software capabilities only.

IX. ENHANCEMENTS IN ORACLE 9i

1. CUSTOMIZABLE CONFIGURATIONS PARAMETER

This command is used to set parameters for all jobs. These data for the parameters are stored in control files which gets sync to the recovery catalog. The recovery window assures that there is a backup present to recover the database at any point of time i.e. of last 10 days and any backup that falls beyond the 10 days limitations will get discarded automatically.

Command: CONFIGURE RETENTION POLICY TO RECOVERY WINDOW OF 10 DAYS;

- a. The redundancy statement states that backup in excess of the latest 10 are no longer required.
Command: CONFIGURE RETENTION POLICY TO REDUNDANCY 4;
- b. When more than one i.e. multiple copies of backup is required this can also be done with the help of configure command.
Command: CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE<device type> TO <no.>;
- c. When can now put all I/O operations to the device type i.e. either on the disk or on the tape.

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Command: CONFIGURE DEFAULT DEVICE TYPE TO [DISK OR SBT];

- d. We can increase the number of parallelism which means after the execution of the command the specified number of channel will get allotted to the process.

Command: CONFIGURE DEVICE TYPE DISK PARALLELISM 2;

- e. The configure command can also be used to exclude tablespace from backup.
With the help of CONFIGURE command we can also force an auto backup of the control file because if the Control file gets lost we would lose catalog.

2. BACKUP AND RESTORE ENHANCEMENTS

- The keep option in backup command can retain backups for longer period than the retention period.
- Backup optimizations technique is used to prevent the backups of read only table spaces.
- Archive logs can also be backed up along with the data files using plus ARCHIVELOG OPTIONS.
- RMAN can use backup set option to copy or move backup sets from disk to tape.

3. RELIABILITY ENHANCEMENTS

- RMAN can take advantage of multiple ARCHIVE LOG retention on any ARCHIVE LOG failover.
- DELETE ALL INPUT options can be used to delete the Multiple ARCHIVELOG backup set after successfully fetching the data from it.
- RMAN performs automatic log switching after the backup or copy operation.
- If a backup block gets corrupt the alternate backup piece can be used which is created at multiple locations.

4. GENERAL ENHANCEMENTS

- The report obsolete command can be used to display archive logs as well as data files which are obsolete now.
- The REPORT NEED BACKUP command reports the files that require to be backed up on the basis of retention policy.
- If files of different block sizes can be backed up easily in the same block, RMAN will separate them accordingly.

X. ENHANCEMENTS IN ORACLE 10G

- a. Flash recovery area available in the database is now managed by the database where flash recovery area is space on the file system or on ASM disk that stores files related to recovery.

b. INCREMENTAL UPDATE BACKUPS

With this feature all the changes done between the SCN of the original image copy and the SCN of incremental backup are applied to the image copy. For example: On the first day normal complete incremental backup will happen for level 0 with all backups at level 1 and after the specified period(default days) merges all incremental backup older than the specified number of days into the level 0 backup.

c. FAST INCREMENTAL BACKUPS

In this version of database it is possible to track the changed blocks using tracking file feature which improves the performance of incremental backup.

d. BACKUP for BACKUPSETS and IMAGE COPIES

In this version of database BACKUP command is extended to initiate backups of image copies and backup sets. Now the RMAN supports the creation of image copies of the data files, control files, archive redo logs, data file copies and control file copies.

e. CATALOGING BACKUP PIECES

This feature extends the functionality to move backup files to any remote location or archiving them manually which can be used further for restoration purpose. In the previous version of the database only available functionality with this is for control files copies, archive log copies and data file copies.

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f. IMPROVED RMAN REPORTING

Oracle 10g includes improved RMAN reporting using V\$ views. It includes

V\$RMAN_OUTPUT: this is in memory view for all the messages reported by RMAN.

V\$RMAN_STATUS: It displays the in-progress and completed jobs of RMAN.

V\$BACKUP_FILES: This view display the information about of all the copies.

CROSS PLATFORM TABLESPACE CONVERSION:

This command allows table space to be transported to different platform with different byte code. The platform of source and destination can be identified with the command V\$TRANSPORTABLE_PLATFORM which is a view and will display the Platform name on which it is compatible.

g. ENHANCED STORED SCRIPTS COMMANDS:

With this enhancement now the script become global and can be accessed by all the databases present inside the recovery catalog.

h. BACKUPSET COMPRESSION:

This feature allows RMAN to compress the binary file of backup sets It is useful in the following conditions:

1. When we perform backups on a network with limited bandwidth.
2. When we perform backups to tape, CD or DVD where hardware compression is not feasible.
3. When we perform disk based backup with limited disk space.

i. MANAGING BACKUP DURATION AND THROTTLING

The duration clause in oracle 10g limits the total time available for a backup to complete. Incomplete backup's gets discarded and are kept and used for future restore operation.

j. DISK TOPOLOGY AND AUTOMATIC PERFORMANCE TUNING:

RMAN uses special topology API which allows to work with different file types available. The information from API gets tunes automatically which reduces human error with less human intervention.

k. AUTOMATIC DATAFILE CREATION:

Recovery Manager automatically create data file under 2 circumstances:

- a. When backup control file contains the reference to data file and no backup of data file exists.
- b. When backup of data file exists but no reference to data file exists in control file.

l. DEFERRED ERROR REPORTING:

It displays the error stack and failed steps for identifying the steps of failure easily.

XI. CONCLUSION

This research paper is done to list down the enhancements among the various versions of database i.e. Oracle database available. This research paper highlights the improvements of the product. This research paper points out the enhancement between the various versions i.e. Oracle 8i, Oracle 9i and Oracle 10g.

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