

# Recovery Manager Oracle Database 10g

## feature overview

May 2004

The most important asset to a company is its data. IS organizations must implement backup solutions to protect that data from sabotage, human error, and hardware failure while achieving a high level of recovery service. Prolonged downtime in an IT infrastructure immediately translates to heightened customer dissatisfaction and ultimately, lost revenue. It is essential as part of an overall high availability plan to ensure that your Oracle data can be efficiently backed up, and more importantly, quickly and accurately restored when needed.

Oracle Recovery Manager (RMAN) is a tool integrated into the Oracle Database that satisfies the pressing demands of high-performance, manageable backup and recovery. RMAN is native to the database server, automatically tracks database structure changes, and optimizes operations accordingly. In addition, RMAN is integrated with leading tape media management products, so that Oracle database backups can be integrated with your existing networked data protection infrastructure.

First introduced in the Oracle8 Database, RMAN has since been updated with numerous enhancements in Oracle9i, including block media recovery, autobackup of control files, and resumable backup/recovery. With the latest release of RMAN in Oracle Database 10g, many new features allow the DBA to:

- Organize and manage backups with Flash Backup and Recovery
- Optimize incremental backup performance via block change tracking
- Reduce the number of full backups to perform with incrementally updated backups
- Administer backup sets and image copies with Enterprise Manager
- Convert tablespaces across platforms.

We will now take a look at each of these new capabilities in detail.

### Flash Backup and Recovery

With the ever-decreasing cost of disk in the marketplace, disk-based backups are often more feasible and functionally advantageous than traditional tape backup. First, backing up to disk circumvents tape-write performance constraints, and second, time-to-recover is reduced by eliminating the need to locate tape and seek to the correct tape location. Leveraging this market trend, RMAN greatly simplifies disk-based backup support with the Flash Recovery Area. The Flash Recovery Area is a single storage location on a filesystem or Automatic Storage Management (ASM) disk group that organizes all recovery-related files and activities for an Oracle database.

All files that are required to fully recover a database from media failure reside in the Flash Recovery Area, including control files, archived log files, data file copies, and RMAN backups. What differentiates the Flash Recovery Area from simply keeping your backups on disk is a set of features for proactive management of backups. For example, obsolete backups and archived logs that fall outside of the RMAN retention policy or are already backed up to tape are automatically removed when there is no disk space to create new files. The flash recovery area

notifies the administrator when its disk space consumption is nearing the defined quota and there are no more files to purge. The administrator can then take action to add more disk space, backup files to tertiary storage, change the retention policy, or delete files. The Flash Recovery Area is managed and configured using Enterprise Manager or via the command line.

### **Optimized Incremental Backups**

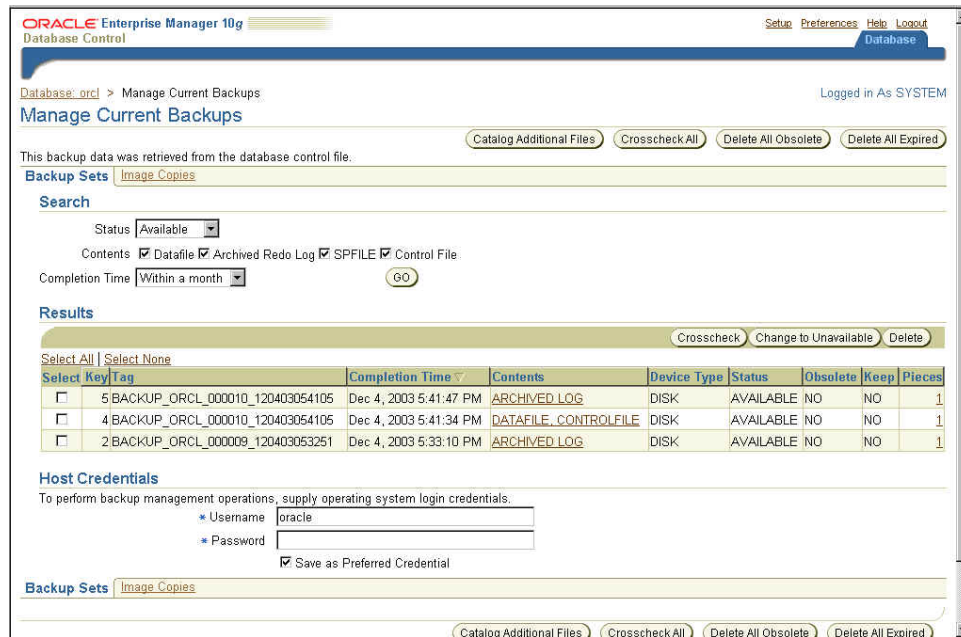
Incremental database backups write data blocks that have changed since a previous backup. RMAN's change tracking feature for incremental backups improves incremental backup performance by recording changed blocks for each datafile in a change tracking file. With block change tracking enabled, incremental backups take less time and subject the system to less overhead. This new feature allows Oracle to record the physical location of all database changes and thus, requires reading less data during each incremental backup, because the majority of the data that hasn't changed since the last backup does not need to be read and examined for changed blocks. Your existing RMAN scripts automatically take advantage of the block change tracking feature once it is enabled.

### **Incrementally Updated Backups**

In Oracle Database 10g, RMAN can merge an incremental backup into a datafile image copy. With this recovery method, RMAN recovers a copy of a data file; that is, you roll forward (recover) the image copy to the specified point in time by applying the incremental backups to the image copy. The image copy is updated with all changes up through the SCN at which the incremental backup was taken. RMAN uses the resulting image copy for media recovery just as it would use a full image copy taken at that SCN, without the overhead of performing a full image copy of the database every day. Time-to-recover is also reduced since the image copy is updated with the latest block changes and fewer redo logs are required to bring the database back to the current state.

### **Enterprise Manager Enhancements**

Oracle Enterprise Manager, a single, integrated solution for administering and monitoring systems and applications based on the Oracle technology stack, includes a set of new features to manage RMAN backups.



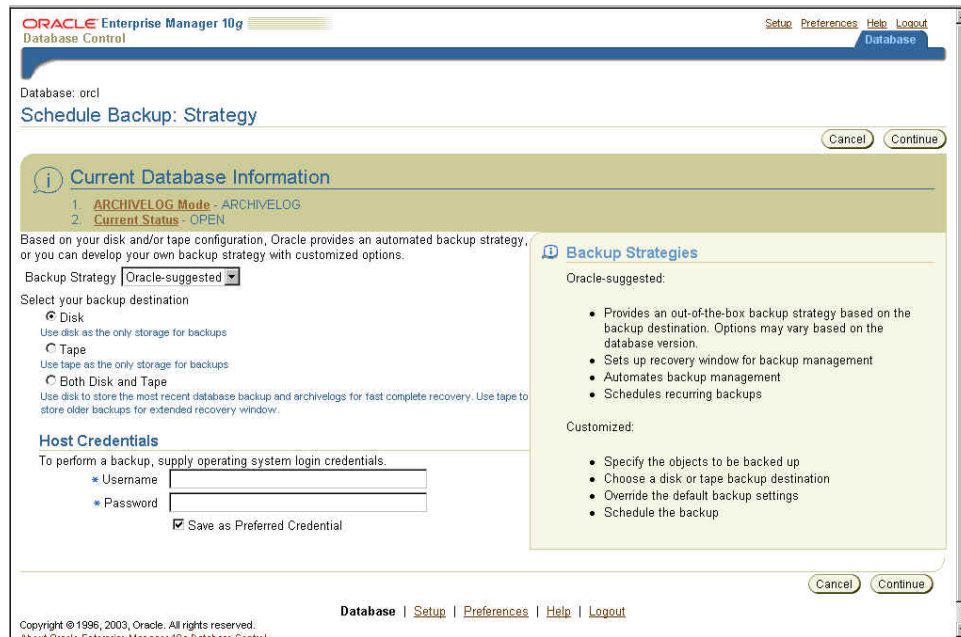
**Figure 1. Enterprise Manager Backup Set Management Console**

With EM's backup management application, RMAN backups can be viewed, with their completion time, backup device type, the type of content (e.g. archived log, data file) contained in each backup set. By drilling down into content type or pieces, each physical file size is displayed. Backup sets can be filtered for viewing according to status, content type, and completion time.

EM simplifies a number of tasks:

- One-step procedure to re-catalog recovery files, to keep the catalog up to date when new files are added to the flash recovery area or the location of the flash recovery area is changed.
- Fast crosscheck validation to ensure that backup information in the recovery catalog or control file is synchronized with actual files on disk or media management catalog
- Modifying backup set availability, e.g. marking a set "unavailable" to RMAN before performing file or system maintenance
- Purging all obsolete or expired sets

EM introduces a pre-configured RMAN backup configuration, the "Oracle-Suggested" Backup Strategy that provides high-performance and efficient recoverability to any point within the last 24 hours by employing Flash Recovery Area, Incrementally Updated Backups, and Block Change Tracking.



**Figure 2. Select Backup Strategy Step in Schedule Backup Wizard**

In this strategy, a full database backup is taken on the first day, followed by an incremental backup on day two. Archived redo logs can be used to recover the database to any point in either day. For day three and onwards, the previous day's incremental backup is merged with the data file copy and a current incremental backup is taken, allowing fast recovery to any point within the last day and redo logs can be used to recover the database to any point during the current day.

Additional EM features include:

- Selecting backup types as image copies or backup sets, with option for compression, making it easier for DBAs to economize disk or tape consumption
- Recovering at the block, table, tablespace, datafile, and database level.
- Performing tablespace-point-in-time recovery (TSPITR)
- Testing backup and restore of control file before performing the actual backup job to validate backup configurations.

### Backup Set Compression

By default, RMAN performs NULL compression, meaning that empty blocks, that have never held data, are not backed up. In Oracle Database 10g, RMAN now goes a step further and can compress backup sets of datafiles and archived logs to better utilize disk space. Binary compression typically reduces backup set size by 50-75%. For text-intensive applications, such as an e-mail database, compression reductions may be significantly greater. Compressed backups can be used directly by RMAN on recovery, reduce overall storage requirements, and allow more backups to be kept on disk for fast recovery.

### Automated Tablespace Point-in-Time Recovery

Tablespace point-in-time recovery (TSPITR) enables you to quickly recover one or more tablespaces in an Oracle database to an earlier time, without affecting the state of the rest of

the tablespaces and other objects in the database. For example, this can be useful to recover from an erroneous truncate table operation. In Oracle Database 10g, RMAN eliminates the need for user intervention by automating the process of instance creation of the auxiliary database and after the completion of the tablespace recovery, cleaning up the auxiliary database files. This new feature makes TSPITR less error-prone, and results in faster overall recovery time.

### Automatic Channel Failover

If RMAN encounters a problem during a backup step, then RMAN will attempt to complete as much of the backup job as possible, rather than aborting the whole backup. Typically, such retrievable errors can occur when a media manager encounters problems with one of several tape drives, or when an instance fails in a RAC environment. Channel failover offers a higher level of resiliency when streaming problems arise and better utilization of system resources, versus restarting jobs manually.

### Recovery through RESETLOGS

Prior to Oracle Database 10g, it is a recommended practice to make a full database backup following a RESETLOGS operation. This is no longer required, as backups (including archived logs) taken prior to the RESETLOGS operation can be used to restore the database to the current or a previous point-in-time should a recovery operation be required. Recovery through RESETLOGS simplifies recovery procedures and allows the database to be opened and made available sooner.

### Enhanced RMAN Scripts

RMAN provides a command-line interface, appropriate for users learning how to use the tool. In live production environments, however, the command-line interface is rarely used, and scripts are used instead. Scripts can be either be created in a text file, available to the RMAN client that has access to the filesystem on which they are stored, or as a stored script in the recovery catalog, which is available to any RMAN client that can connect to the target database (for which the script was created) and recovery catalog.

Oracle Database 10g offers several enhancements to make it easier to use scripts. First, scripts in text files can be easily converted to stored scripts, and vice versa. Second, the concept of global scripts is introduced, which allows any target database connecting to the recovery catalog to be able to use the same scripts, and eliminates the need to create identical local scripts for each target database.

### Simplified & Enhanced RMAN Commands

#### RMAN COPY Obsolescence

The RMAN COPY command has been replaced by the BACKUP AS COPY command; allowing a database, multiple tablespaces, data files, or archived logs to be copied in a single command, rather than having to use a RMAN COPY command for each single file.

#### RMAN Backup Throttling

In Oracle Database 10g, RMAN backup rate can be throttled to fit within a backup window, a period of time during which a backup activity must complete, to meet required service levels. For example, you may want to restrict your database backup activities to a window of time when user activity on your system is low, such as between 2:00 AM and 6:00 AM.

The DURATION option for the RMAN BACKUP command allows RMAN to automatically compute the rate of backup (bytes/sec/file) based on:

- A backup window (e.g. 4 hours)
- Optional parameter to minimize time or system load within the specified backup window

With the `MINIMIZE TIME` optional parameter, RMAN attempts to perform the backup as fast as possible under the specified duration, with little attention to system load. With `MINIMIZE LOAD`, RMAN will reduce the backup rate if it can detect that the job will complete before the end of the specified backup window.

### Automatic Data File Creation

When a new tablespace or datafile is added, it must then be immediately backed up with a separate RMAN job. With automatic datafile creation, this separate job is no longer needed. RMAN will recreate the datafiles automatically upon `RESTORE` or `RECOVER` command, provided that all archived logs dating back to the creation of the datafile are available.

### Proxy Copy Archived Log Backups

Archived logs can now be backed up and restored by a media manager that supports the RMAN Proxy Copy feature.

### Cataloging Backup Pieces and Multiple Files

The process of adding backup metadata to the RMAN repository is known as cataloging. Cataloging a backup piece, with the `CATALOG` command, adds it to the RMAN repository so that it is available for use in recovery operations.

In addition, multiple files can be cataloged with a single command, using the new `CATALOG START WITH` command. The `CATALOG START WITH` command will automatically detect the type of file that is being examined, and catalog its information appropriately.

These new commands are useful to keep the catalog updated, when you make a copy of a backup piece or image copy with an operating system utility, or when you move a backup piece or image copy from one disk to another so that it has a different pathname.

### Drop Database

When a database is no longer needed, the `DROP DATABASE` command can be used to remove all of a database's files, including data files, online logs, control files, and, optionally, archivelogs and backups.

### Unregister Database

The `UNREGISTER DATABASE` command deletes all recovery catalog data for one target database. Since this command does not remove any information from the control file, you can still register this database in the same or a different recovery catalog.

### Backup/Restore Standby Controlfile

RMAN can back up a standby database's controlfile. To back up the standby controlfile, use the normal `BACKUP` command while connected to the standby database. When restoring a controlfile, you can specify that a standby controlfile will be restored by using the `STANDBY` option on the `RESTORE` command.

## Enhanced RMAN Reporting

### Enhanced V\$ Views

The V\$RMAN\_OUTPUT view shows the output of all currently executing and recently executed RMAN jobs. The V\$RMAN\_STATUS view indicates the status of both executing and completed RMAN commands. The V\$BACKUP\_FILES provides access to the information used as the basis of the LIST BACKUP and REPORT OBSOLETE commands. DBAs can easily embed queries to these views in SQL scripts, and write their output to text file for historical recording or analysis purposes.

### Deferred Error Reporting

Instead of immediately terminating a backup operation upon the first error, RMAN will report errors in the output when they occur and then continue to execute the command if possible. If RMAN can retry a job step on another channel, then it will report a message to this effect. If some job steps could not be completed, then the error stack at the end of command execution will display errors for failed steps.

### RESTORE PREVIEW

The RESTORE command supports a PREVIEW option, which identifies the backups required to carry out a given restore operation based on the information in the RMAN repository. Use RESTORE PREVIEW when planning your restore and recovery operation, to ensure that all required backups are available or to identify situations in which you may want to direct RMAN to use or avoid specific backups.

## Cross-Platform Transportable Tablespace Conversion

Transporting tablespaces from one Oracle Database 10g platform to another that has different byte ordering (e.g. from Solaris to Linux) requires conversion of the datafiles. This conversion is provided by the new CONVERT command, which accepts a tablespace name, destination platform name from V\$TRANSPORTABLE\_PLATFORM, and destination directory where the converted datafiles will be generated.

Cross-platform transportable tablespace provides:

- Content providers the ability to publish structured data as transportable tablespaces and distribute it to customers who can easily and efficiently integrate this data into their Oracle databases, regardless of their chosen platform.
- Distribution of data from a large data warehouse server to data marts on smaller computers (for example, Windows NT workstations).
- Sharing of read-only tablespaces across a heterogeneous cluster.

### Restore Last Valid Backup

During a restore, when RMAN finds corruption in a backup, or finds that a backup cannot be accessed, RMAN will try to restore the desired file from all possible backups before returning an error. This is done automatically whenever RMAN restores file(s) during the RESTORE or RECOVER command, eliminating the need to search for valid backups and re-trying the operation when a restore failure occurs.

### **Automatic Storage Management (ASM) Support**

- RMAN can back up and restore whole ASM disk groups. Furthermore, RMAN is the only method to back up and restore individual ASM files.
- Backup sets and image copies can be created in ASM, either by automatically creating them in the flash recovery area, or by explicitly specifying an ASM disk group for their location.
- RMAN can be used to migrate existing databases and files from non-ASM storage into ASM.

### **Oracle Managed Files (OMF) Support**

- RMAN can backup and restore OMF files without having to use the complete OMF filenames in the commands.
- Backup sets and image copies can be created as OMF files by creating them in the Flash Recovery Area.
- RMAN can be used to migrate existing files to OMF.

### **Summary**

A complete high availability strategy requires proven, dependable data backup, restore, and recovery procedures. Recovery Manager is the Oracle solution for efficiently backing up and recovering your Oracle data.

New Oracle Database 10g capabilities include:

- Managing recovery-related files with flash recovery area
- Optimized incremental backups using block change tracking
- Reducing the time and overhead of full backups with incrementally updated backups
- Comprehensive backup job tracking and administration with Enterprise Manager

These features in addition to numerous other enhancements establish RMAN as the most compatible, high-performance, feature-rich, automated backup and recovery tool for the Oracle database.

**KEY ORACLE DATABASE 10g RECOVERY MANAGER NEW FEATURES & BENEFITS**

<b>Feature</b>	<b>Benefit</b>
Flash Recovery Area	Single directory and automated, proactive management of all recovery-related files
Block Change Tracking	Faster incremental backups
Incrementally Updated Backups	Eliminates the need for full database backups and reduces time to recovery
Enterprise Manager Enhancements <ul style="list-style-type: none"> <li>Backup Set/Image Copies Management</li> <li>Backup Files Re-Cataloging</li> <li>Crosscheck Validation</li> <li>“Oracle-Suggested” Backup Strategy</li> </ul>	<ul style="list-style-type: none"> <li>Single GUI to view/modify available status of files in backup set</li> <li>One-step procedure to keep catalog up to date</li> <li>Ensure that backup information in the recovery catalog/control file is synchronized with actual files on disk/media management catalog</li> <li>Allows DBAs to recover database to any point within last 24 hours</li> </ul>
Automated Tablespace Point-in-Time Recovery	Eliminates manual intervention and speeds up tablespace recovery.
Automatic Channel Failover on Backup & Restore	Provides better toleration of media failures
Cross-Platform Tablespace Conversion	Easily transport data across heterogeneous platform environments
RMAN Commands Enhancements <ul style="list-style-type: none"> <li>Autogenerate Data Files During Recovery</li> <li>Backup Throttling</li> <li>DROP DATABASE</li> <li>Tablespace Rename</li> <li>Proxy Copy Archived Log Backups</li> <li>Cataloging Backup Pieces</li> </ul>	<ul style="list-style-type: none"> <li>No need to perform backup after new data file is created.</li> <li>Better control over system resources, lessen impact to overall database performance on backup</li> <li>Assists with clean up of orphaned data files</li> <li>Useful when transporting tablespace to other databases</li> <li>Media managers can perform archived log backup and restore, while RMAN catalogs</li> <li>Useful after copying a backup piece with an operating system utility, or moving backup piece from one disk to another</li> </ul>
RMAN Reporting Enhancements <ul style="list-style-type: none"> <li>RESTORE PREVIEW</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that all required backups are available, instruct RMAN to use or avoid specific backups.</li> </ul>
Recovery after RESETLOGS	Enhanced database availability
Restore Last Valid Backup	Tolerates corrupt or missing backups, alleviates need to manually search for valid backups
Backup Set Binary Compression	Reduces backup set size by 50-75%
RMAN Scripts Enhancements <ul style="list-style-type: none"> <li>Global Stored Scripts</li> </ul>	<ul style="list-style-type: none"> <li>Eliminate the need to create scripts local to each target database</li> </ul>