

# Chapter 1

## Configuring Recovery Manager

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### ORACLE DATABASE 10G: ADMINISTRATION II EXAM OBJECTIVES COVERED IN THIS CHAPTER:

#### ✓ Configuring Recovery Manager

- Configure database parameters that affect RMAN operations.
- Change RMAN default settings with CONFIGURE.
- Manage RMAN's persistent settings.
- Start the RMAN utility and allocate channels.



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The Oracle *Recovery Manager (RMAN)* is the recommended backup and recovery tool provided with the Oracle Database Server 10g software. RMAN was first introduced in Oracle 8, and Oracle has steadily made enhancements and improvements with each new release of Oracle to meet the heavy demands required for database backup and recovery.

RMAN has grown to meet the demands of exponentially larger database sizes and more stringent availability requirements. Database servers have grown in size with technology gains of CPU, bus architectures, and more efficient disk subsystems. Disk costs have steadily decreased to more affordable and acceptable levels and have now become an economic alternative to tape storage.

RMAN has been redesigned in Oracle 10g to support these contemporary database environments. RMAN now places more focus on backing up and recovering the changes to the database instead of the complete database. This allows RMAN to support backups of larger databases and recover in faster timeframes.

This chapter discusses configuring and setting up RMAN. Configuring RMAN is the first step in the RMAN process. RMAN must be set up and configured to each environment's requirements. We will walk through this process in detail through examples and demonstrations.

This chapter walks through the parameters for RMAN that are demonstrated in the configuration settings. You will perform the basics of starting RMAN and configuring or setting up RMAN. The remainder of this chapter focuses on more complex topics such as autobackups using the control file.



This chapter takes you through a review of the common RMAN features. The review will demonstrate these features with examples. Where applicable, you will walk through the new 10g features and capabilities of RMAN.

The next few chapters discuss topics such as “Using RMAN,” “Recovering from Non-critical Losses,” “Flashback Database,” “Recovering from User Errors,” and “Database Corruption.”

## Exploring the Features and Components of RMAN

RMAN has many capabilities to facilitate the backup and recovery process. RMAN comes in both web-based GUI and command-line versions. In general, RMAN performs and standardizes the

backup and recovery process, which can reduce mistakes made during this process. Below is a list of some of the existing RMAN features:

- Backup databases, tablespaces, datafiles, control files, and archive logs
- Compressing backups by determining which blocks have changed, and backing up only those blocks
- Performing change-aware incremental backups
- Providing scripting capabilities to combine tasks
- Logging backup operations
- Integrating with third-party tape media software
- Providing reports and lists of catalog information
- Storing information about backups in a catalog in an Oracle database
- Offering performance benefits, such as parallel processing of backups and restores
- Creating duplicate databases for testing and development purposes
- Testing whether backups can be restored successfully
- Determining whether backups are still available in media libraries

RMAN has many improvements to support new functionality and different database failures that were not supported before Oracle 10g. In addition, RMAN can handle larger database backups and recoveries in quicker timeframes. This means less availability impact during the backup and recovery process. Here is a list of new 10g RMAN features:

- Migrating datafiles across operating system platforms
- User error recovery with flashback
- Automated tablespace point-in-time recovery (TSPITR)
- Dropping a database
- Using backup copies and flash recovery
- Creating and using RMAN backup copies
- Configuring default disk backup types
- Recovering datafiles not backed up
- Blocking change tracking
- Unregistering a database from the catalog
- Actual compression of RMAN backups
- Error-reporting improvements

RMAN has a rich feature set that is improving dramatically with each release of Oracle. These features allow you to back up and recover a database in almost any situation. Many of these new features address problems or difficulties that you will encounter in your daily tasks.

Other features such as flash recovery, block change tracking, and actual backup compression are innovations within RMAN that allow a DBA to support evolving database requirements.

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The main components of RMAN are GUI or command-line access, the optional recovery catalog, the RMAN commands and scripting, and tape media connectivity. These components enable you to automate and standardize the backup and recovery process. Each component is described as follows:

**GUI or command-line interface method** The web-enabled GUI or *command-line interface (CLI)* provides access to Recovery Manager. This process spawns off-server sessions that connect to the *target database*, which is the database that will be backed up. The GUI access is provided through the Oracle Enterprise Manager's web-based console. The Oracle *Enterprise Manager (EM)* tool performs backups, exports/imports, data loads, performance monitoring/tuning, job and event scheduling, and standard DBA management, to mention a few. The EM tool is a web-based application and must be run through a browser.

**Recovery catalog** The *recovery catalog* is recovery information that is stored inside an Oracle database. This is similar to the RMAN repository stored in the control file, but information stored in the recovery catalog is more extensive. It is a special data dictionary of backup information that is stored in a set of tables, much like the data dictionary stores information about databases. The recovery catalog provides a method for storing information about backups, restores, and recoveries. This information can provide status on the success or failure of backups, operating system backups, datafile copies, tablespace copies, control file copies, archive log copies, full database backups, and the physical structures of a database.

**RMAN commands** RMAN commands enable different actions to be performed to facilitate the backup and restore of the database. These commands can be organized logically into scripts, which can then be stored in the recovery catalog database. The scripts can be reused for other backups, thus keeping consistency among different target database backups.

**Tape media connectivity** Tape media connectivity provides a method for interfacing with various third-party tape hardware vendors to store and track backups in *automated tape libraries (ATLs)*. Oracle supports many tape hardware devices. ATLs are tape units that use robotics arms and bar-coded tapes to automate the usage of multiple tapes for backup purposes.

## RMAN Usage Considerations

*RMAN backup* is a physical backup method that was first developed with Oracle 8 and has steadily improved with each Oracle release. If you are going to use RMAN, you can use disk or tape. If you are using tape, a third-party media management library is needed to interface with your tape hardware.

There are two other methods of backup and recovery in the Oracle database: user-managed and the Oracle EXPORT utility. *User-managed backups* are essentially customized scripts that interact with the operating system capabilities such as `copy` and `compress` commands. These types of backups have been the mainstay of Oracle backups prior to and during the initial release of RMAN.

The *EXPORT utility* executed with the *exp* executable is essentially a logical backup utility that performs backups only on the logical components of the database. A logical backup consists of backing up the database at the tablespace level or backing up other logical database components such as a table. A physical backup consists of backing up the database files such as the datafiles, control files, and redo logs. This is one of the reasons *EXPORT* is typically not considered a stand-alone backup method but provides additional backup protection for RMAN or a user-managed backup.



In Oracle 10g, there is a new *EXPORT* utility, which is different from the standard *EXPORT* utility that is executed with the *exp* command. The new Oracle 10g *EXPORT* utility that supports data pump technology is called *expdp*. The new *expdp* *EXPORT* utility does not have the same functionality as the standard *exp* *EXPORT* utility.

RMAN performs many recovery options that are not supported by other available backup and recovery methods. Table 1.1 compares the capabilities of each backup method.

Starting the RMAN utility is a very straightforward process. To start RMAN, you need to be at the command line at the operating system level. In the case of a Windows environment, you would be at the DOS prompt.

**TABLE 1.1** Different Backup Methods Capabilities

Capability	RMAN	User-Managed	EXPORT Utility
Server parameter file backups	Supported	Supported	Not supported
Password file backups	Not supported	Supported	Not supported
Closed database backups	Supported	Supported	Not supported
Open database backups	Supported	Not supported	Not supported
Incremental backups	Supported	Not supported	Not supported
Corrupt block detection	Supported	Not supported	Supported
Automatic backup file	Supported	Not supported	Supported
Backup catalogs	Supported	Not supported	Supported
Media manager	Supported	Supported	Supported
Platform independent	Supported	Not supported	Supported

## RMAN Repository and Control Files

The RMAN utility uses two methods of storing information about the target databases that are backed up. Oracle calls the collection of metadata about the target databases the *RMAN repository*. There are two methods of storing data in the RMAN repository. The first method is by accessing an RMAN catalog of information about backups. The second method is by accessing the necessary information about backups in the target database's control files.

Oracle recommends that you store RMAN backup data in the catalog database as opposed to the RMAN repository for most medium-sized to enterprise environments. This allows full functionality of the RMAN utility. This catalog is another Oracle database with special RMAN catalog tables that store metadata about backups, much the same way that the data dictionary stores data about objects in the database. When using the recovery catalog, backup scripts can be created and stored in the catalog database for later use, and multiple target database can be backed up from a central source. This catalog database can also be backed up so that the information is made safe.

The RMAN utility enables you to use a target database without utilizing the recovery catalog database. The target database is the database targeted by RMAN for backup or recovery actions. Because most of the recovery catalog information is stored in the target database's control file, RMAN supports the ability to use just the control file to perform backup and recovery operations. This method would be used if the overhead of creating and maintaining a recovery catalog were too great for an organization.



The recovery catalog database will be covered in more detail in the next section "RMAN Using the Recovery Catalog."

If you use RMAN without the recovery catalog, you are storing most of the necessary information about each target database in the target database's control file. In this case, the target database's control file is the repository. Thus, you must manage the target database's control file to support this. The `init.ora` or `spfile.ora` parameter `CONTROL_FILE_RECORD_KEEP_TIME` determines how long information that can be used by RMAN is kept in the control file. The default value for this parameter is 7 days and can be as many as 365 days. The greater the number, the larger the control file becomes to store more information.



The control file can only be as large as the operating system allows.

The information that is stored within the control file is stored in the reusable sections called *circular reuse records* and *non-circular reuse records*. These sections can grow if the value of the parameter `CONTROL_FILE_RECORD_KEEP_TIME` is 1 or more. The circular reuse records have non-critical information that can be overwritten if needed. Some of the non-circular reusable sections consist of datafiles and redo log information.



In the next section, we will discuss the recovery catalog in detail. The recovery catalog is not the default method of storing data in the RMAN repository. You must set up and configure the recovery catalog and database before you can utilize this capability.

## RMAN Using the Recovery Catalog

Before demonstrating how to use the recovery catalog, let's discuss briefly its capabilities and components. The recovery catalog is designed to be a central storage place for multiple databases' RMAN information. Unlike using the control file as a repository, the recovery catalog can support multiple Oracle databases or an enterprise environment. This centralizes the location of the RMAN information instead of having this information dispersed in each target database's control file.

The main components of the RMAN recovery catalog support the logging of the backup and recovery information in the catalog. This information is stored in tables, views, and other databases' objects within an Oracle database. Here is a list of the components contained in a recovery catalog:

- Backup and recovery information that is logged for long-term use from the target databases
- RMAN scripts that can be stored and reused
- Backup information about datafiles and archive logs
- Information about the physical makeup, or schema, of the target database

The recovery catalog is similar to the standard database catalog in that the recovery catalog stores information about the recovery process as the database catalog stores information about the database. The recovery catalog must be stored in its own database, preferably on a server other than the server where the target database resides. To enable the catalog, an account with CONNECT, RESOURCE, and RECOVERY\_CATALOG\_OWNER privileges must be created to hold the catalog tables. Next, the catalog creation script command must be executed as the user RMAN\_USER connected to the RMAN utility.

Let's walk through the creation of the recovery catalog step by step:



This example assumes that you have already built a database called ora101rc to store the recovery catalog. Oracle recommends that the default size of the recovery catalog database be about 115mb including datafiles and redo logs.

1. First, you must point to the database where the recovery catalog will reside. This is not the target database. The RMAN database will be called ora101rc. The oraenv shell script is provided by Oracle to switch to other databases on the same server. Use the following command:

```
Microsoft Windows XP [Version 5.1.2600]  
(C) Copyright 1985-2001 Microsoft Corp.
```

```
C:\Documents and Settings\dstuns>set ORACLE_SID=ora101rc
```

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2. Create the user that will store the catalog. Use the name RMAN with the password RMAN. Make DATA the default tablespace and TEMP the temporary tablespace:

```
C:\Documents and Settings\>sqlplus /nolog
```

```
SQL*Plus: Release 10.1.0.2.0 - Production on Sun Jun 13 06:17:34 2004
```

```
Copyright (c) 1982, 2004, Oracle. All rights reserved.
```

```
SQL>
```

```
SQL> connect /as sysdba
```

```
SQL> create user rman_user identified by rman_user
```

```
2 default tablespace data
```

```
3 temporary tablespace temp;
```

```
User created.
```

3. Grant the appropriate permissions to the RMAN user:

```
SQL> grant connect, resource, recovery_catalog_owner to rman_user;
```

```
Grant succeeded.
```

```
SQL>
```

4. Launch the RMAN tool:

```
C:\Documents and Settings\>rman
```

```
Recovery Manager: Release 10.1.0.2.0 - Production
```

```
Copyright (c) 1995, 2004, Oracle. All rights reserved.
```

5. Connect to the catalog with the user called RMAN that you created in step 2:

```
RMAN> connect catalog rman_user/rman_user
```

```
connected to recovery catalog database
```

```
recovery catalog is not installed
```

6. Finally, create the recovery catalog by executing the following command and specifying the tablespace that you want to store the catalog in:

```
RMAN> create catalog tablespace data;
```

```
recovery catalog created
```

```
RMAN>
```

Once the recovery catalog is created, there are a few steps that must be performed for each target database so that backup and recovery can be stored. The first step is registering the database. Once an incarnation of the database is registered, data may be stored in the recovery catalog for that particular target database. An incarnation of the database is a reference for a database in the recovery catalog.



Let's walk through registering a database and then using the recovery catalog by running a full backup:

```
C:\Documents and Settings>rman target /  
Recovery Manager: Release 10.1.0.2.0 - Production  
Copyright (c) 1995, 2004, Oracle. All rights reserved.
```

```
connected to target database: ORA101T (DBID=2615281366)
```

```
RMAN> connect catalog "rman_user/rman_user@ora101rc";
```

```
connected to recovery catalog database
```

```
RMAN> register database;
```

```
database registered in recovery catalog  
starting full resync of recovery catalog  
full resync complete
```

```
RMAN>
```

Once the target database has been registered, you can back up the target database. This will store the backup data in the recovery catalog. From this point on, all of RMAN can be utilized in the backup and recovery process for the backed-up target database.

To perform this you must connect to the target database, which in this example is `ora101t` in the Windows XP environment. Then you can connect to the recovery catalog in the `ora101rc` database.

Once connected to the proper target and catalog, you can execute the appropriate RMAN backup script. This script will back up the entire database. Next, the database can be restored with the appropriate RMAN script. Finally, the database can be opened for use.

Let's walk through this example step by step:

1. Set the `ORACLE_SID` to `ora101t`, which is your target database, so that the database can be started in MOUNT mode with SQL\*Plus:

```
C:\Documents and Settings>set ORACLE_SID=ora101t
```

```
C:\Documents and Settings>sqlplus /nolog  
SQL*Plus: Release 10.1.0.2.0 - Production on Sun Jun 13 07:06:16 2004  
Copyright (c) 1982, 2004, Oracle. All rights reserved.
```

```
SQL>  
SQL> connect /as sysdba  
Connected to an idle instance.  
SQL> startup mount  
ORACLE instance started.
```

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```
Total System Global Area  88080384 bytes
Fixed Size                  787588 bytes
Variable Size              78642044 bytes
Database Buffers           8388608 bytes
Redo Buffers                262144 bytes
Database mounted.
```

2. Start the RMAN utility at the command prompt and connect to the target and the recovery catalog database ora101rc:

```
C:\Documents and Settings>rman
Recovery Manager: Release 10.1.0.2.0 - Production
Copyright (c) 1995, 2004, Oracle. All rights reserved.
```

```
RMAN> connect target
```

```
connected to target database: ORA101T (DBID=2615281366)
```

```
RMAN> connect catalog rman_user/rman_user@ora101rc;
```

```
connected to recovery catalog database
```

```
RMAN>
```

3. Once connected to the target and recovery catalog, you can back up the target database, including archive logs, to disk or tape. In this example, choose disk. Give the database name a format of `db_%u_%d_%s`, which means that a `db_` will be concatenated to the backup set unique identifier and then concatenated to database name with the backup set number:

```
RMAN> run
2> {
3> allocate channel c1 type disk;
4> backup database format 'db_%u_%d_%s';
5> backup format 'log_t%t_s%s_p%p'
6> (archive log all);
7> }
```

```
allocated channel: c1
channel c1: sid=49 devtype=DISK
```

```
Starting backup at 15-JUN-04
channel c1: starting full datafile backupset
channel c1: specifying datafile(s) in backupset
```

```
input datafile fno=00001
  name=C:\ORACLE\ORADATA\ORA101T\SYSTEM01.DBF
input datafile fno=00003
  name=C:\ORACLE\ORADATA\ORA101T\SYS_AUX01.DBF
input datafile fno=00005
  name=C:\ORACLE\ORADATA\ORA101T\EXAMPLE01.DBF
input datafile fno=00002
  name=C:\ORACLE\ORADATA\ORA101T\UNDOTBS01.DBF
input datafile fno=00004
  name=C:\ORACLE\ORADATA\ORA101T\USERS01.DBF
channel c1: starting piece 1 at 15-JUN-04
channel c1: finished piece 1 at 15-JUN-04
piece handle=C:\WINDOWS\SYSTEM32\DB_04FODN6N_ORA101T_4
  comment=NONE
channel c1: backup set complete, elapsed time: 00:01:57
channel c1: starting full datafile backupset
channel c1: specifying datafile(s) in backupset
including current controlfile in backupset
channel c1: starting piece 1 at 15-JUN-04
channel c1: finished piece 1 at 15-JUN-04
piece handle=C:\WINDOWS\SYSTEM32\DB_05FODNAC_ORA101T_5
  comment=NONE
channel c1: backup set complete, elapsed time: 00:00:05
Finished backup at 15-JUN-04

Starting backup at 15-JUN-04
channel c1: starting archive log backupset
channel c1: specifying archive log(s) in backup set
input archive log thread=1 sequence=7 recid=1 stamp=527413772
input archive log thread=1 sequence=8 recid=2 stamp=527414322
input archive log thread=1 sequence=9 recid=3 stamp=528706062
channel c1: starting piece 1 at 15-JUN-04
channel c1: finished piece 1 at 15-JUN-04
piece handle=C:\WINDOWS\SYSTEM32\LOG_T528932180_S6_P1
  comment=NONE
channel c1: backup set complete, elapsed time: 00:00:09
Finished backup at 15-JUN-04
released channel: c1

RMAN>
```

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4. Once the backup is complete, the database may be restored and recovered. The database must be mounted but not opened. In the restore and recovery script, choose three disk channels to utilize parallelization of the restore process. This is not necessary but improves the restore and recovery time. The RESTORE DATABASE command is responsible for the restore process within RMAN. RECOVER DATABASE is required because the database was in ARCHIVELOG mode and these files need to be applied to the datafiles to perform a complete recovery. Lastly, the database is opened:

```
RMAN> run
```

```
2> {
```

```
3> allocate channel c1 type disk;
```

```
4> allocate channel c2 type disk;
```

```
5> allocate channel c3 type disk;
```

```
6> restore database;
```

```
7> recover database;
```

```
8> alter database open;
```

```
9> }
```

```
allocated channel: c1
```

```
channel c1: sid=49 devtype=DISK
```

```
allocated channel: c2
```

```
channel c2: sid=48 devtype=DISK
```

```
allocated channel: c3
```

```
channel c3: sid=47 devtype=DISK
```

```
Starting restore at 15-JUN-04
```

```
channel c1: starting datafile backupset restore
```

```
channel c1: specifying datafile(s) to restore from backup set
```

```
restoring datafile 00001 to
```

```
  C:\ORACLE\ORADATA\ORA101T\SYSTEM01.DBF
```

```
restoring datafile 00002 to
```

```
  C:\ORACLE\ORADATA\ORA101T\UNDOTBS01.DBF
```

```
restoring datafile 00003 to
```

```
  C:\ORACLE\ORADATA\ORA101T\SYSAUX01.DBF
```

```
restoring datafile 00004 to C:\ORACLE\ORADATA\ORA101T\USERS01.DBF
```

```
restoring datafile 00005 to
```

```
  C:\ORACLE\ORADATA\ORA101T\EXAMPLE01.DBF
```

```
channel c1: restored backup piece 1
```

```
piece handle=C:\WINDOWS\SYSTEM32\DB_04FODN6N_ORA101T_4
```

```
tag=TAG20040615T213412
channel c1: restore complete
Finished restore at 15-JUN-04
```

```
Starting recover at 15-JUN-04
```

```
starting media recovery
media recovery complete
```

```
Finished recover at 15-JUN-04
```

```
database opened
released channel: c1
released channel: c2
released channel: c3
```

```
RMAN>
```



A typical target database uses only about 120mb of space per year in the recovery catalog database for metadata storage.

## Starting and Connecting to RMAN

There are a few other important notes regarding starting RMAN such as a target database designation and specifying a recovery catalog. We will explore activating these designations when starting RMAN.

RMAN can be started by launching the RMAN executable. RMAN can be stopped by exiting or quitting from the RMAN prompt.

Let's walk through this in more detail:

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.
```

```
C:\Documents and Settings>rman
```

```
Recovery Manager: Release 10.1.0.2.0 - Production
```

```
Copyright (c) 1995, 2004, Oracle. All rights reserved.
```

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RMAN>

RMAN> **exit**

Recovery Manager complete.

C:\Documents and Settings>

Once in the RMAN utility, backup configuration changes and restores can be performed. In order to perform these RMAN activities, it is important to know the three database connection types using the RMAN utility. Table 1.2 describes the three database connections available with RMAN. The subsequent examples will walk through the most common database connections: target database and recovery catalog database connections.

**TABLE 1.2** RMAN Database Connection Methods

Database Connection	Definition
Target database	The target database is the database that is targeted for backup and recovery. SYSDBA privilege is required to perform these tasks.
Recovery catalog database	The recovery catalog database is the optional database that stores information about the backup, recovery, and restore data.
Auxiliary database	The auxiliary database is the standby database, duplicate database, or auxiliary instance (standby or TSPITR).

There are two methods of connecting to the target database: from the command line and using the RMAN utility.

Let's walk through designating a target database with each method. First, connect from the command line:

1. Set the Oracle system identifier (SID):

```
Microsoft Windows XP [Version 5.1.2600]  
(C) Copyright 1985-2001 Microsoft Corp.
```

```
C:\Documents and Settings>set ORACLE_SID=ora101c
```

2. Launch the RMAN executable, specifying the target and default connection on the command line. NOCATALOG is optional, but if left blank, this is the default.

```
C:\Documents and Settings>rman target / nocatalog
```

```
Recovery Manager: Release 10.1.0.2.0 - Production
```

Copyright (c) 1995, 2004, Oracle. All rights reserved.

connected to target database: ORA101C (DBID=1736563848)

RMAN>

Next, we will show you how to connect to the target database within the RMAN utility. This is quite similar to the previous example, except that you are at the RMAN command prompt when you specify the target database. Let's walk through this example:

1. Set the Oracle system identifier (SID):

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.
```

```
C:\Documents and Settings>set ORACLE_SID=ora101c
```

2. Launch the RMAN executable:

```
C:\Documents and Settings>rman
```

```
Recovery Manager: Release 10.1.0.2.0 - Production
```

Copyright (c) 1995, 2004, Oracle. All rights reserved.

RMAN>

3. Connect to the target database by executing the `connect target` command:

```
RMAN> connect target
```

connected to target database: ORA101C (DBID=1736563848)

RMAN>

Connecting to a recovery catalog is a fairly straightforward process. Just as when connecting to the target database, there are two methods of performing this activity: on the command line and within the RMAN utility.

First, let's walk through an example of connecting to the recovery catalog at the command line:

1. Set the Oracle SID:

```
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.
```

```
C:\Documents and Settings>set ORACLE_SID=ora101c
```



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2. Launch the RMAN executable specifying the target, the catalog and catalog owner, and the database containing the catalog.

```
C:\Documents and Settings>rman target / catalog rman_user/rman_user@ora101rc
```

```
Recovery Manager: Release 10.1.0.2.0 - Production
```

```
Copyright (c) 1995, 2004, Oracle. All rights reserved.
```

```
connected to target database: ORA101C (DBID=1736563848)
connected to recovery catalog database
```

```
RMAN>
```

Next, you will connect to both the target database and the recovery catalog database within the RMAN utility. This is quite similar to the previous example, except that you are at the RMAN command prompt when you specify the target database and recovery catalog database. Let's walk through this example:

1. Set the Oracle SID:

```
C:\Documents and Settings>set ORACLE_SID=ora101t
```

2. Start the RMAN utility and connect to the target database:

```
C:\Documents and Settings>rman
```

```
Recovery Manager: Release 10.1.0.2.0 - Production
```

```
Copyright (c) 1995, 2004, Oracle. All rights reserved.
```

```
RMAN> connect target
```

```
connected to target database: ORA101T (DBID=2615281366)
```

3. Connect to the recovery catalog specifying the username and password of the RMAN catalog owner:

```
RMAN> connect catalog rman_user/rman_user@ora101rc;
```

```
connected to recovery catalog database
```

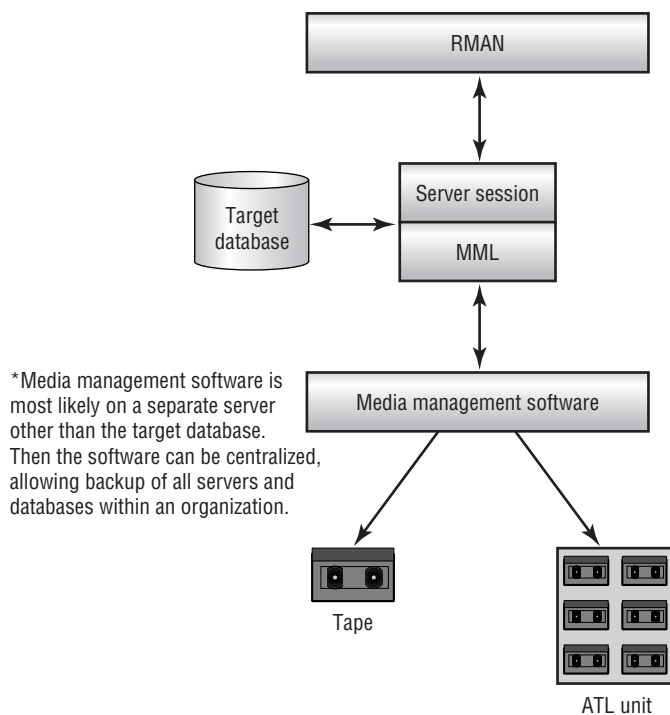
```
RMAN>
```

## Describing Media Management Layer

The *media management layer (MML)* interface is an Application Programming Interface (API) that interfaces RMAN and different hardware vendors' tape devices. These tape devices, as mentioned earlier in this chapter, are automated tape libraries (ATLs).

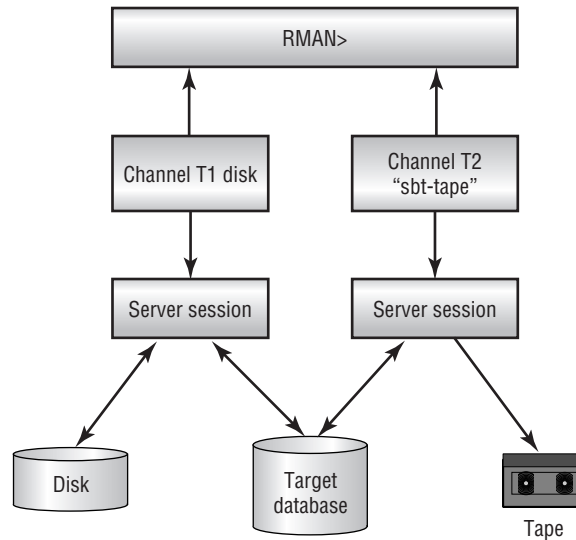
All tape hardware vendors that wish to work with Oracle RMAN make their own MML. This is necessary because most tape hardware devices are proprietary and require different program calls. The MML is then linked in with Oracle database kernel, so that the RMAN server process and MML can read and write the Oracle data to the tape device. Figure 1.1 illustrates this concept.

**FIGURE 1.1** The media management layer (MML)



## Describing Channel Allocation

*Channel allocation* is a method of connecting RMAN and the target database while also determining the type of I/O device that the server process will use to perform the backup or restore operation. Figure 1.2 illustrates this situation. The I/O device can be either tape or disk. Channels can be allocated manually or automatically.

**FIGURE 1.2** Channel allocation

*Manual channel allocation* is performed any time you issue the command `ALLOCATE CHANNEL`. A manual command for allocating a channel is `ALLOCATE CHANNEL channel name TYPE DISK`. This is used for writing to a disk file system. The command `ALLOCATE CHANNEL channel name TYPE 'SBT_TAPE'` is another manual method used for writing to a tape backup system. These are the most common channel allocation usages. Allocating a channel is initiated with the `ALLOCATE CHANNEL` command, which starts a server process on the server of the target database.

*Automatic channel allocation* is performed by setting the RMAN configuration at the RMAN command prompt. This is done by using the `CONFIGURE DEFAULT DEVICE` or `CONFIGURE DEVICE` command. Automatic channel allocation is automatically used when executing the `BACKUP`, `RESTORE`, or `DELETE` commands. The complete listing of automatic channel allocation is as follows:

```

CONFIGURE DEVICE TYPE DISK backup|clear|parallelism n
CONFIGURE DEFAULT DEVICE TYPE to|clear
CONFIGURE CHANNEL DEVICE TYPE disk|equal
CONFIGURE CHANNEL n DEVICE TYPE disk|equal

```

There are some default naming conventions for the devices `ORA_MAINT_DISK_n` and `ORA_SBT_TAPE_n`. The following example shows that the default device type is set to disk and parallelism is set to 1. This means that if you don't allocate a channel manually, the parameters will be listed as follows:

```
RMAN> show all;
```

RMAN configuration parameters are:

```
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default
```

```
CONFIGURE BACKUP OPTIMIZATION OFF; # default
CONFIGURE DEFAULT DEVICE TYPE TO DISK; # default
CONFIGURE CONTROLFILE AUTOBACKUP OFF; # default
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO '%F'; # default
CONFIGURE DEVICE TYPE DISK PARALLELISM 1 BACKUP TYPE TO BACKUPSET; # default
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE MAXSETSIZE TO UNLIMITED; # default
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE; # default
CONFIGURE SNAPSHOT CONTROLFILE NAME TO 'C:\ORACLE\PRODUCT\10.1.0\DB_1\DATABASE\SNCFORA101T.ORA'; # default
```

RMAN>

### Multiple Backup Types on Your Tapes?

Your tape backup device could be supporting multiple backups that may be RMAN-based as well as normal file system backups. Most ATLs and the software support file system backups and RMAN backups are backed up with the same tape media. That means you could have each type of backup on a tape, especially since digital linear tapes (DLTs) support large storage volumes of 200GB or more per tape, meaning file system backups and RMAN backups could be interspersed on a single tape.

You should be aware that there are potentially two types of backups on the same tape. If you are heavily dependent on tapes for recovery operations, make sure that the tape cycle that your organization uses supports the requirements of the file system backup or the RMAN backup that is needed for the longest period of time.

For example, file system backups are needed for only one week until the next complete backup file system backup is taken on the weekend. RMAN backups may be needed up to a month to support business requirements. Therefore, you should store all the tapes for up to a month and if possible, procure additional tapes so you can keep backups separated.

There are also channel control options or commands that are used whether channels are allocated manually or automatically. *Channel control options* or *channel control commands* basically control the operating system resources that RMAN uses when performing RMAN operations. Channel control options or commands perform the functions described in Table 1.3.

**TABLE 1.3** Channel Commands and Options

Channel Control Option or Command	Functions
ALLOCATE CHANNEL RATE or CONFIGURE CHANNEL RATE	Limits the I/O bandwidth in kilobytes, megabytes, or gigabytes
ALLOCATE CHANNEL or CONFIGURE CHANNEL MAXPIECESIZE	Limits the size of the backup pieces
ALLOCATE CHANNEL or CONFIGURE CHANNEL MAXSETSIZE	Limits the size of the backup sets
SEND	Sends vendor-specific commands to the Media Manager
ALLOCATE CHANNEL CONNECT or CONFIGURE CHANNEL CONNECT	Instructs a specific instance to perform an operation
ALLOCATE CHANNEL PARMS or CONFIGURE CHANNEL PARMS	Sends vendor-specific parameters to the Media Manager

New with Oracle 10g is an *automated channel failover* for backup and restore operations. In order for this feature to function, multiple channels must be allocated. If there is a failure in the backup or restore operations, RMAN will complete the operation with the available channels. This can commonly happen when multiple backups attempt to use a one tape device or when there is an MML problem of some sort.

Error messages are reported in the V\$RMAN\_OUTPUT dynamic view. Error information is also logged to the screen or the RMAN log file when MML comes across any problems.

## Parameters and Persistent Settings for RMAN

Configuring *persistent settings* or parameters for RMAN is handled through the configuration settings for each target database. There are many RMAN settings that help automate or simplify using RMAN. Be familiar with where these settings are located and how to modify them for a particular database environment. These settings are stored in the target databases control file or the recovery catalog.

This section explains how to display and set configuration parameters for RMAN and demonstrates these features with examples. You will then walk through the new RMAN parameters in Oracle 10g.

Let's show how you can display the configuration for a particular RMAN session. This is a fairly straightforward process that requires logging into RMAN and performing the `SHOW ALL` command:

1. Set the Oracle SID for the target database:

```
C:\Documents and Settings\dstuns>set ORACLE_SID=ora101c
```

2. Launch the RMAN utility from the command line:

```
C:\Documents and Settings\dstuns>rman
```

```
Recovery Manager: Release 10.1.0.2.0 - Production
```

```
Copyright (c) 1995, 2004, Oracle. All rights reserved.
```

```
RMAN>
```

3. Connect to the target database:

```
RMAN> connect target
```

```
connected to target database: ORA101C (DBID=1736563848)
```

```
RMAN>
```

4. Perform the `show all` command to display all the configuration parameters:

```
RMAN> show all;
```

```
RMAN configuration parameters are:
```

```
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default
CONFIGURE BACKUP OPTIMIZATION OFF; # default
CONFIGURE DEFAULT DEVICE TYPE TO DISK; # default
CONFIGURE CONTROLFILE AUTOBACKUP OFF; # default
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO '%F'; #
    ↳default
CONFIGURE DEVICE TYPE DISK PARALLELISM 1 BACKUP TYPE TO BACKUPSET; # default
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE CHANNEL DEVICE TYPE DISK FORMAT '/oracle/flash_recovery_area/
    ↳ora101c
    /%rec_area_%s_%p.bak';
CONFIGURE MAXSETSIZE TO UNLIMITED; # default
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE; # default
CONFIGURE SNAPSHOT CONTROLFILE NAME TO 'C:\ORACLE\PRODUCT\10.1.0\DB_
    ↳1\DATABASE\S
```

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```
NCFORA101C.ORA'; # default
```

```
RMAN>
```

There are some commonly used configuration settings that help you use RMAN. These settings are useful in daily operations:

- DEVICE TYPE
- BACKUP TYPE
- COMPRESSED BACKUPSET
- CHANNEL DISK DEVICE
- CHANNEL TAPE DEVICE

Let's learn how to modify or set each of these configuration settings in more detail.

To configure the default device to tape and then to disk, use the following command. This command sets the default media for RMAN to store the backup information:

```
RMAN>configure default device type to sbt;
```

```
RMAN>configure default device type to disk;
```

To configure the default backup type for an image copy and then for a backup set, use the following command. This parameter or setting configures the type of backup to be an image copy or a backup set:

```
RMAN>configure device type disk backup type to copy;
```

```
RMAN>configure device type disk backup type to backupset;
```

To configure a default device for either tape or disk to a compressed backup set, here are two specific examples:

```
RMAN>configure device type disk backup type to compressed backupset;
```

```
RMAN>configure device type sbt backup type to compressed backupset;
```

To configure disk devices and channels for specific formats, the next example shows that a channel is storing the output on disk and storing the name with the specific naming format. The 'ora\_dev\_' string is concatenated to a special naming format. Formatting is an excellent method of naming your backups uniquely for easy identification.



See the following sidebar, "Format Specifications for the 10g RMAN FORMAT Option," for a more detailed listing of the FORMAT option's formatspec values. The complete information can be found in the Oracle Database 10g Recovery Manager Reference Guide, part number B10770-02.



### Format Specifications for the 10g *RMAN FORMAT* Option

The following list includes some of the format specifications for the *FORMAT* option. For a complete listing, see the Oracle Database 10g Recovery Manager Reference Guide, part number B10770-02.

- %a** Specifies the activation ID of the database.
- %c** Specifies the copy number of the backup piece within a set of duplexed backup pieces.
- %d** Specifies the name of the database.
- %D** Specifies the current day of the month from the Gregorian calendar.
- %e** Specifies the archived log sequence number.
- %f** Specifies the absolute file number.
- %F** Combines the database identifier (DBID), day, month, year, and sequence number into a unique and repeatable generated name.
- %h** Specifies the archived redo log thread number.
- %I** Specifies the DBID.
- %M** Specifies the month in the Gregorian calendar in format *MM*.
- %N** Specifies the tablespace name.
- %n** Specifies the name of the database, padded on the right with *n* characters to a total length of eight characters.
- %p** Specifies the piece number within the backup set.
- %s** Specifies the backup set number.
- %t** Specifies the backup set timestamp.
- %T** Specifies the year, month, and day in the Gregorian calendar.
- %u** Specifies an eight-character name constituted by compressed representations of the backup set or image copy number.
- %U** Specifies a system-generated unique filename. (This is the default.)

Let's look at an example of configuring a disk device and channel for a specific format:

```
RMAN>configure channel device type disk format 'C:\backup\ora101c\
      ➔ora_dev_f%t_s%s_s%p' ;
```

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The next example demonstrates how to configure tape devices and channels to utilize specific media management capabilities that control the tape hardware. In this case, some media managers allow you to pass in configuration settings with a PARMS string in the CONFIGURE command. Let's look at this example:

```
RMAN>configure channel device type sbt PARMS='ENV=mm1_env_settings';
```

```
RMAN>configure device type sbt parallelism 3;
```

# Configuring RMAN Settings with Enterprise Manager

RMAN settings can be configured using Enterprise Manager (EM). In Oracle 10g, EM is a web-based console, which allows most DBA activities to be performed from a GUI screen instead of from the typical command-line interface. The main home page can be accessed at `http://hostname.domain:EM_portnumber/em`. The hostname is the server or machine and can be identified by typing **hostname** at the Unix or Windows command prompt. The domain name is the name of network you are on. The domain name varies for whatever network you are on, for instance, `sybex.com`. Also, the port number for the first database with EM agent running is 5500, which is the default. Each additional database increments this port number by 1. So, an additional database on this server will be listening on port 5501. In the examples in this chapter, you have installed the EM Database Control as opposed to Grid Control, which is an additional software component to support 10g Grid Control options.

We will demonstrate how to access EM. Once in the web application, you will navigate to the screens that are capable of modifying the configuration settings.

Let's look at the EM screens that allow the configuration of some of the RMAN settings:

1. First, enter `http://hostname.domain:5500/em` in the web browser to get to the EM main home page, which take you to the following login screen. The hostname is the name of the computer or server that is running EM, which is **dstuns-xp** and the network domain. At this point, enter the user id **SYS** and its password and connect as **SYSDBA**.



- After logging in and clicking the Login button, the main EM Database Control main page appears, as you can see in the following graphic. (Notice that we saved this as two screens because of the size.) The Maintenance table will be selected to navigate to the maintenance screens that contain the screens that allow configuration modifications:

**ORACLE Enterprise Manager 10g**  
Database Control

Database: ora101

Home | Performance | Administration | Maintenance

Page Refreshed Oct 25, 2004 7:47:09 PM [Refresh](#)

View Data: [Manually](#)

**General**

Status: Up  
Up Since: Oct 25, 2004 7:42:51 PM  
Time Zone: MST  
Availability (%): 9.37 (Last 24 hours)  
Instance Name: ora101  
Version: 10.1.0.2.0  
Read Only: No  
Oracle Home: C:\oracle\product10.1.0\db\_1  
Listener: LISTENER\_DSTUNS-XP.ds.boeing.com  
Host: DSTUNS-XP.ds.boeing.com

**Host CPU**

Run Queue: 1.0  
Paging (pages per second): Unavailable

**Active Sessions**

Active Sessions: 0.03  
SQL Response Time (%): 330.56 (continued to baseline)

**High Availability**

Instance Recovery Time (seconds): 37  
Last Backup: Sep 8, 2004 11:38:43 PM  
Archiving: Enabled  
Archive Area Used (%): 81  
Flashback Logging: Disabled

**Space Usage**

Database Size (GB): 1  
Problem Tablespace: 0  
Segment Findings: Not Configured  
Policy Violations: 0  
Dump Area Used (%): 81

**Diagnostic Summary**

Performance Findings: 0  
All Policy Violations: 32  
Alert Log: Oct 1, 2004 10:22:32 PM

**Alerts**

Severity	Category	Name	Message	Alert Triggered	Last Value	Time
Warning	Archive Area	Archive Area Used (%)	81% of archive area c:\oracle\oraarch\ora101\ is used.	Oct 18, 2004 10:17:36 PM	81	Oct 18, 2004 10:17:36 PM
Warning	Alert Log	Generic Alert Log Error	ORA-error stack (00604, 04031) logged in C:\ORACLE\ADMIN\ORA101\BDUMP\alert_ora101.log.	Sep 8, 2004 9:03:58 PM	0	
Warning	Alert Log	Generic Alert Log Error	ORA-error stack (12012, 04031, 06512, 06512, 06512, 06512) logged in C:\ORACLE\ADMIN\ORA101\BDUMP\alert_ora101.log.	Sep 8, 2004 9:03:58 PM	0	
Warning	Invalid Objects by Schema	Owner's Invalid Object Count	19 object(s) are invalid in the PUBLIC schema.	Sep 28, 2004 9:35:09 PM	19	Sep 28, 2004 9:35:09 PM
Warning	Invalid Objects by Schema	Owner's Invalid Object Count	21 object(s) are invalid in the SYS schema.	Sep 28, 2004 9:35:09 PM	21	Sep 28, 2004 9:35:09 PM

**Related Alerts**

Severity	Target Name	Target Type	Category	Name	Message	Alert Triggered	Last Value	Time
Warning	LISTENER_DSTUNS-XP.ds.boeing.com	Listener	Response	Response Time (msec)	Listener response to a TNS ping is 290 msec.	Oct 25, 2004 7:47:11 PM	290	Oct 25, 2004 7:47:11 PM
Warning	DSTUNS-XP.ds.boeing.com	Host	Filesystems	Filesystem Space Available (%)	Filesystem C:\ has only 19.3% available space.	Oct 18, 2004 10:09:52 PM	19.3	Oct 18, 2004 10:09:52 PM

**Job Activity**

Jobs scheduled to start no more than 7 days ago

Scheduled Executions: 0  
Running Executions: 0  
Suspended Executions: 0  
Problem Executions: 0

**Critical Patch Advisories**

Patch Advisories: 0  
Oracle Metalink Credentials: Not Configured

Home | Performance | Administration | Maintenance

**Related Links**

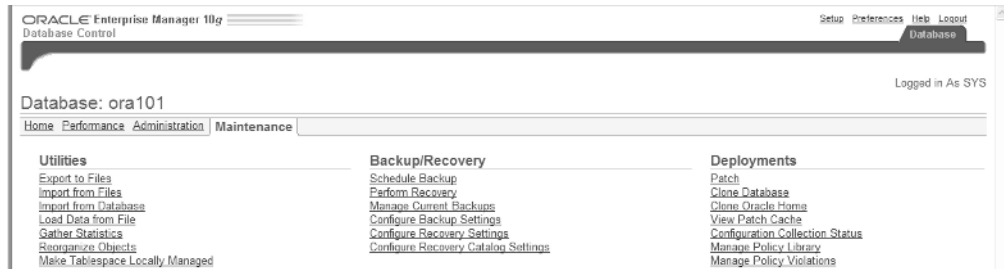
Advisor Central  
All Metrics  
Jobs  
Monitoring Configuration

Alert History:  
Blackouts  
Manage Metrics  
User-Defined Metrics

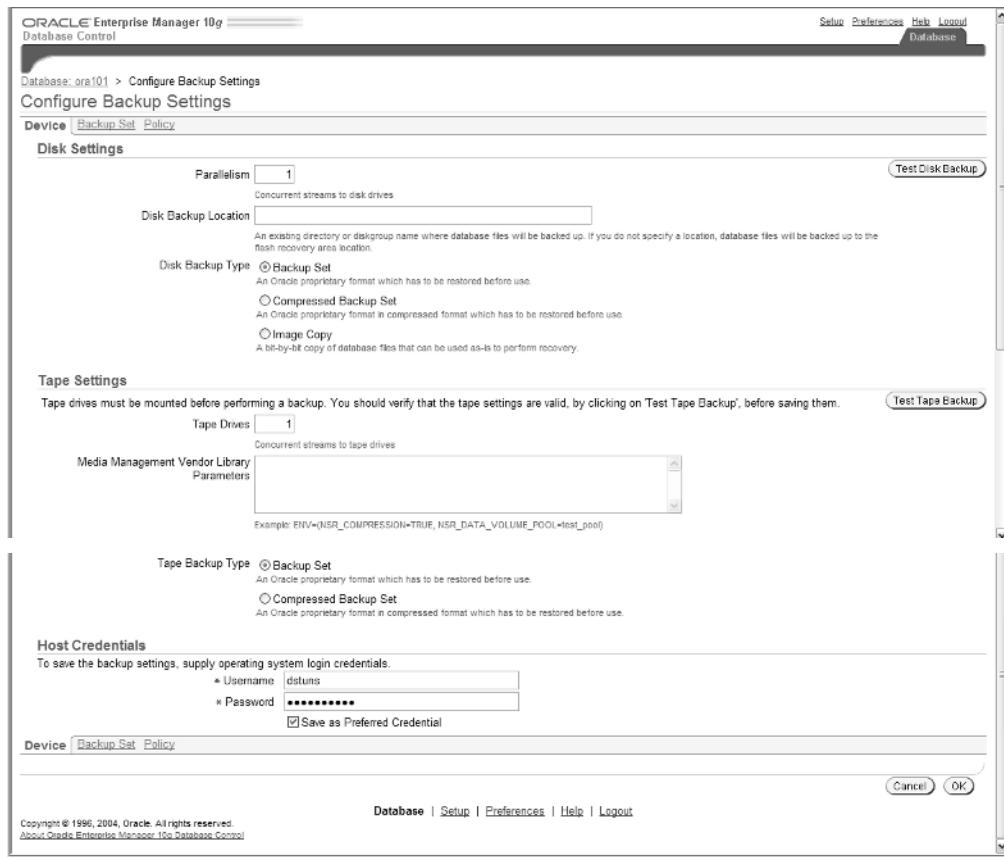
Alert Log Content  
iSQL\*Plus  
Metric Collection Errors

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- Next, select the Backup/Recovery section and click Configure Backup Settings, which will navigate to one of the configuration settings screens available in EM Database Control:



- This screen displays the configuration settings for backups. These values can be modified, which will have the same effect as the RMAN command CONFIGURE. There are also configurations settings for recovery and the recovery catalog.





It is important to know that an account equal to the Windows Administrator account or that account itself should be used in the Host Credentials sections for the Windows environment. In the Unix environment, the Oracle account or similar privileged account should be used. This is because the EM 10g web applications essentially host out to the operating system to execute these commands with RMAN CLI.

## Describing Retention Policies

The *retention policy* is the determined length of time that a backup is retained for use in a potential restore. The retention policy is determined by the configuration parameter `RETENTION POLICY`. This can be displayed with the `SHOW ALL` command.

Backups can be modified to block or obsolete their status from the retention policy. The commands `CHANGE` and `KEEP` modify the backup to be blocked from the retention policy. Two other commands—`CHANGE` and `NOKEEP`—obsoletes the backup from the existing retention policy.

Let's walk through an example of modifying a database retention policy:

```
RMAN> show all;
```

RMAN configuration parameters are:

```
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default
CONFIGURE BACKUP OPTIMIZATION OFF; # default
CONFIGURE DEFAULT DEVICE TYPE TO DISK; # default
CONFIGURE CONTROLFILE AUTOBACKUP ON;
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO
  'c:\oracle\stagi
ng\ora101c\cf_%F';
CONFIGURE DEVICE TYPE DISK PARALLELISM 1 BACKUP TYPE TO BACKUPSET; # default
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1; # default
CONFIGURE CHANNEL DEVICE TYPE DISK FORMAT
  '/oracle/flash_recovery_area/ora101c
/%rec_area_%s_%p.bak';
CONFIGURE MAXSETSIZE TO UNLIMITED; # default
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE; # default
CONFIGURE SNAPSHOT CONTROLFILE NAME TO
  'C:\ORACLE\PRODUCT\10.1.0\DB_1\DATABASE\S
NCFORA101C.ORA'; # default
```

```
RMAN>
```

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Next, you should have a retention policy set to a number of days. You will arbitrarily set 30 days retention as a monthly backup retention period. (In real life, this value would be agreed upon by the IT management.) What this means is that backups are kept for only 30 days within the recovery catalog. You will do this with the `CONFIGURE RETENTION POLICY TO RECOVERY WINDOW OF n DAYS` configuration setting, as seen here:

```
RMAN> configure retention policy to recovery window of 30 days;
```

new RMAN configuration parameters:

```
CONFIGURE RETENTION POLICY TO RECOVERY WINDOW OF 30 DAYS;
```

new RMAN configuration parameters are successfully stored

```
RMAN>
```

Next, let's create a backup and use the `TAG` clause to mark this backup with a unique name called `MONTHLY_BACKUP`. `TAG` is a clause that identifies a specific name to a backup so that it can be more easily identified. So this backup is governed by the retention policy you created of 30 days:

```
RMAN> run
```

```
2> {
```

```
3> allocate channel c1 type disk;
```

```
4> backup database format 'db_%u_%d_%s' tag monthly_backup;
```

```
5> backup format 'log_t%t_s%s_p%p'
```

```
6> (archivelog all);
```

```
7> }
```

Next, you can modify or change this backup so that the backup will not be kept until the end of retention policy. Let's learn how to cause a backup to expire so that it is not protected by the retention policy:

```
RMAN> change backupset tag monthly_backup nokeep;
```

allocated channel: ORA\_DISK\_1

channel ORA\_DISK\_1: sid=162 devtype=DISK

keep attributes for the backup are deleted

backup set key=6 recid=6 stamp=531831641

```
RMAN>
```

Next, you can modify or change the backup to block the 30-day retention policy you just had expire. Let's look at the command that blocks or excludes this backup from expiring in 30 days,

which is the existing retention policy. You will set this backup to be kept until 01-DEC-04 by using the KEEP UNTIL TIME clause:

```
RMAN> change backupset tag monthly_backup keep until time '01-DEC-04' logs;
```

```
using channel ORA_DISK_1
```

```
keep attributes for the backup are changed
```

```
backup will be obsolete on date 01-DEC-04
```

```
archived logs required to recover from this backup will expire when
```

```
    ↳this backup expires
```

```
backup set key=6 recid=6 stamp=531831641
```

```
RMAN>
```

## Configuring the Control File Autobackup

RMAN can be configured to automatically back up the control file and other server parameter files whenever information impacting the control file is changed or modified. This is a valuable asset to a backup because this allows RMAN to recover the database even if the control file or server parameter file is lost. This process is called *control file autobackup*.

The common naming of the server parameter file and control file allow RMAN to search and restore these files without accessing the RMAN repository. Once the control file is restored and mounted, the RMAN repository becomes available. RMAN can then use the repository information to restore datafiles and archive logs.

Configuring the autobackup of the control file is a straightforward process that is handled by the CONFIGURE command. Let's walk through an example:

```
RMAN> configure controlfile autobackup on;
```

```
using target database controlfile instead of recovery catalog
```

```
new RMAN configuration parameters:
```

```
CONFIGURE CONTROLFILE AUTOBACKUP ON;
```

```
new RMAN configuration parameters are successfully stored
```

```
RMAN>
```

You can also configure the format of the autobackup of the control file. This is performed by specifying a format setting in the CONFIGURE command. Let's look at an example:

```
RMAN> configure controlfile autobackup format
```

```
2> for device type disk to 'c:\oracle\staging\ora101c\cf_%F';
```



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new RMAN configuration parameters:

```
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO  
    'c:\oracle\stagi  
ng\ora101c\cf_%F';
```

new RMAN configuration parameters are successfully stored

RMAN>

## Summary

This chapter presented an overview of RMAN capabilities and components. We walked through starting, setting up, and configuring RMAN. The chapter used specific examples, which showed how to build the recovery catalog and establish connectivity using the recovery catalog and control file.

There was a demonstration using Enterprise Manager to configure RMAN settings. We discussed channel allocation and media management in conceptual format to show their importance to RMAN.

Throughout this chapter, we described the many new 10g features and capabilities that have been added to the existing RMAN functionality.

## Exam Essentials

**Know how to configure database parameters that affect RMAN operations.** You should know the database parameters that impact RMAN operations. These parameters include `CONTROL_FILE_KEEP_TIME` and others.

**Know how to change RMAN default settings with *CONFIGURE*.** Make sure you know the many capabilities of RMAN's existing 9i features and the new 10g features. Be aware that there are four main components of RMAN: GUI or CLI, optional recovery catalog, RMAN commands, and tape media connectivity. Understand the concepts surrounding RMAN repository, RMAN recovery catalog, channel allocation, and MML interface. This includes creating, configuring, and using these features.

**Understand how to manage RMAN's persistent settings.** Know how to modify and display RMAN settings and parameters. Be aware of the persistent settings that are used to automate daily RMAN activities.

**Understand starting RMAN utility and channel allocation.** Be aware of the review activities relating to starting and stopping RMAN and the connection types associated with the RMAN utility such as target database and recovery catalog. Understand what the media management layer and channel allocation are and how they work with RMAN.

## Review Questions

1. What is the parameter that determines the capacity of the RMAN repository?
  - A. CONTROLFILE\_RECORD\_KEEP\_TIME
  - B. CONTROL\_FILE\_KEEP\_TIME
  - C. CONTROL\_FILE\_RECORD\_KEEP\_TIME
  - D. CONTORL\_FILE\_RECORD\_TIME
2. What privileges must be granted to allow an account to create the recovery catalog? (Choose two.)
  - A. RECOVERY\_CATALOG\_OWNER
  - B. DBA
  - C. RESOURCE
  - D. SELECT ANY DICTIONARY TABLE
3. What are the types of devices that channel allocation can utilize? (Choose all that apply.)
  - A. TYPE DISK
  - B. DISK TYPE
  - C. TYPE SBT\_TAPE
  - D. TYPE FLASH\_AREA
4. Which command configures a device so that channel allocation is automatically available during backup, restore, or delete?
  - A. CONFIGURE DEVICE TYPE TO DISK
  - B. CONFIGURE CHANNEL DEVICE TYPE DISK
  - C. CHANNEL DEVICE TYPE DISK CONFIGURE
  - D. CONFIGURE DEVICE CHANNEL TYPE DISK
5. What is the name of the API that interfaces RMAN with different tape devices?
  - A. Media Library Interface
  - B. Media Manager Library Interface
  - C. Management Media Interface
  - D. Media Management Layer
6. What backup capability is not supported with RMAN?
  - A. Password file backups
  - B. Closed database backups
  - C. Control file backups
  - D. Open database backups

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7. What are the database connection types available with RMAN? (Choose all that apply.)
  - A. Target database
  - B. Recovery catalog
  - C. Third-party database
  - D. Auxiliary database
8. What is the main purpose of channel control options or commands?
  - A. To control channel access options
  - B. To control the operating system resources RMAN uses when performing RMAN operations
  - C. To control manual channel allocation
  - D. To control automatic channel allocation
9. The **FORMAT** command within the RMAN utility performs what function?
  - A. It provides the capability for unique identification.
  - B. It provides the capability to recreate channel devices.
  - C. It provides the capability to rebuild channel devices.
  - D. It provides the capability to rebuild disk devices.
10. What command displays the settings for automatic channel setup?
  - A. **SHOW CONFIGURATION**
  - B. **SHOW CHANNEL**
  - C. **SHOW ALL**
  - D. **SHOW DEVICE**
11. Which new 10g feature allows Oracle RMAN to store larger databases?
  - A. The **COMPRESSED BACKUPSET** command
  - B. Block change tracking
  - C. The flash recovery area
  - D. Automated tablespace point-in-time recovery (TSPITR)
12. Which new 10g feature allows Oracle RMAN to back up larger databases more efficiently?
  - A. The **COMPRESSED BACKUPSET** command
  - B. The Oracle Flashback Database
  - C. Block change tracking
  - D. Automated tablespace point-in-time recovery (TSPITR)

13. The BACKUP command is different from image copies in what way?
- A. A backup set is stored in proprietary format using the BACKUP command.
  - B. A backup set can be compressed using the BACKUP command.
  - C. The RESTORE command must be used during recovery.
  - D. All of the above
14. Which RMAN components are *not* required to utilize Recovery Manager? (Choose all that apply.)
- A. Media management layer (MML)
  - B. Command line interface (CLI)
  - C. Recovery catalog
  - D. Enterprise Manager (EM)
15. What do you call the RMAN information stored in the control files that is written over when necessary?
- A. Writeable information
  - B. Non-reusable information
  - C. Circular reuse records
  - D. Non-circular reuse
16. In order to perform parallelization of backup and restore operations, you would need at least what set up? (Choose all that apply.)
- A. One channel allocated
  - B. Multiple channels allocated
  - C. PARALLISM configured to 1
  - D. PARALLISM configured to 2
17. After database login to Enterprise Manager, what is required in order to perform most backup and recovery tasks? (Choose all that apply.)
- A. System database account
  - B. Sys database account
  - C. Oracle Unix operating system account
  - D. Administrator Windows operating system account
18. Which of the following statements is true about RMAN persistent settings?
- A. Persistent settings can control device type.
  - B. Persistent settings can control backup type.
  - C. Persistent settings can control channel device.
  - D. All of the above

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- 19.** Where are RMAN persistent settings stored? (Choose all that apply.)
- A.** Target database catalog
  - B.** Recovery catalog database
  - C.** Control file
  - D.** Parameter file
- 20.** What feature is *not* a new feature of Oracle 10g RMAN?
- A.** User error recovery with flashback
  - B.** Automated tablespace point-in-time recovery (TSPITR)
  - C.** Compressing backups by only backing up changed blocks
  - D.** Compressing the backup sets regardless of whether blocks in the datafiles are mainly used

## Answers to Review Questions

1. C. The `CONTROL_FILE_RECORD_KEEP_TIME` parameter is the parameter that determines the size of the RMAN repository or target database's control file when not using the recovery catalog.
2. A, C. The `RECOVERY_CATALOG_OWNER` and `RESOURCE` privileges are required to create the recovery catalog. The `DBA` privilege includes `RESOURCE` and `CONNECT` and will work, but this role has many additional privileges that are unneeded. `SELECT ANY DICTIONARY TABLE` is not required.
3. A, C. The `TYPE DISK` parameter allocates a channel to disk. The `TYPE SBT_TAPE` parameter allocates a channel to tape. These are the two correct device types.
4. B. The correct configure command is `CONFIGURE CHANNEL DEVICE TYPE DISK`. When using the `CONFIGURE` command, the information is stored as a default so that it doesn't need to be specified in backup, restores, or deletes.
5. D. The Media Management Layer (MML) is the API that interfaces RMAN with different vendor tape devices.
6. A. Password file backups are not supported with the RMAN utility.
7. A, B, D. The database connection types supported with RMAN are target database, recovery catalog, and auxiliary database.
8. B. The channel options and commands are used to control the operating system resources that RMAN uses. Specifically, the `RATE` and `DURATION` options protect a RMAN backup from consuming all operating system resources.
9. A. The `FORMAT` command allows for unique identification of a backup or image copy.
10. C. The `SHOW ALL` command displays all configuration settings, including automated channel setup settings. These are also known as the persistent settings.
11. A. The `COMPRESSED BACKUPSET` command allows you to compress backup sets to a smaller size, allowing for storage of larger databases.
12. C. Block change tracking allows RMAN to back up only changed blocks from the last backup. The blocks are identified in a journaling system to expedite the process.
13. D. All of the answers describe capabilities of the `BACKUP` command that are not available when using the image copy method of backing up.
14. A, C, D. The command-line interface is always required to use RMAN. EM, the recovery catalog, and MML are not mandatory to use RMAN.
15. C. The circular reuse records contain information that will be written over when necessary.
16. B, D. Multiple channels are needed to allow backup or recovery functions to be processed over each. The `PARALLELISM` parameter can be configured to a number greater than 1, and this allocates multiple channels for parallelization.

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- 17.** C, D. EM uses the operating system account with significant privileges to run RMAN to perform operations. The Oracle account is needed on Unix and the administrator account or its equivalent in the Windows environment.
- 18.** D. RMAN persistent settings can control or define devices, backups, and channels. Persistent settings control all values available in the `SHOW ALL` command.
- 19.** B, C. Persistent settings are stored in the control file of the target database when using the control file as the repository. Persistent settings are also stored in the recovery catalog when using the recovery catalog as the repository.
- 20.** C. Compression backup by backing up only changed blocks was the primary method of compression prior to 10g. Now with 10g, backups can be compressed regardless of the used or unused blocks.