RMAN - From Beginner to Advanced

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Introduction

The Oracle Recovery Manager is the main tool for backup and recovery of the Oracle database. It is very important for all DBA's to understand how it's working and how to resolve any issues with backups and more importantly to understand how to recover database in the different scenarios.
My work experience is showing me that junior DBA's are using Recovery Manager mostly through Oracle Enterprise Manager and some of them are afraid or don't know how to use command line interface.
This presentation is going to cover RMAN concepts and show examples of how to deal with typical back and recovery scenarios and how to interpret scripts and RMAN output logs. It will cover a concept of Recovery Manager channel and typical backup, restore and recover commands.
In addition to that, maintenance of backups including adding, cross checking and delete of backup set in the typical scenarios.

Recovery Manager concept

Recovery Manager is a part of an Oracle database. It's built into kernel of database and it has a PL/SQL API.

Recovery Manager has two interfaces: command line interface (rman command) and GUI interface (Oracle Cloud Control or Oracle Enterprise Manager). GUI interface has a faster learning curve but it also has more limitations. All jobs defined by GUI are generating scripts executed by command line interface.

Client command (rman) can be connected to managed database in same way like SQLPlus is connected to database: using SQL*Net network or local connection. Recovery Manager user must have the followed role: SYSDBA role in 11g or at least SYSBACKUP in 12c.

Client parses single commands or scripts created by DBA or generated automatically by GUI.
If script can't be parsed due to syntax errors, all errors are reported immediately to the user. After the parsing phase, a final version of script is translated into PL/SQL and executed on the database server. If there are errors during a runtime, error messages are sent back by server to client and displayed there.

When Recovery Manager is connected to an Oracle database, a dedicated server process is started and this process is responsible for coordination of backup and recovery operations.

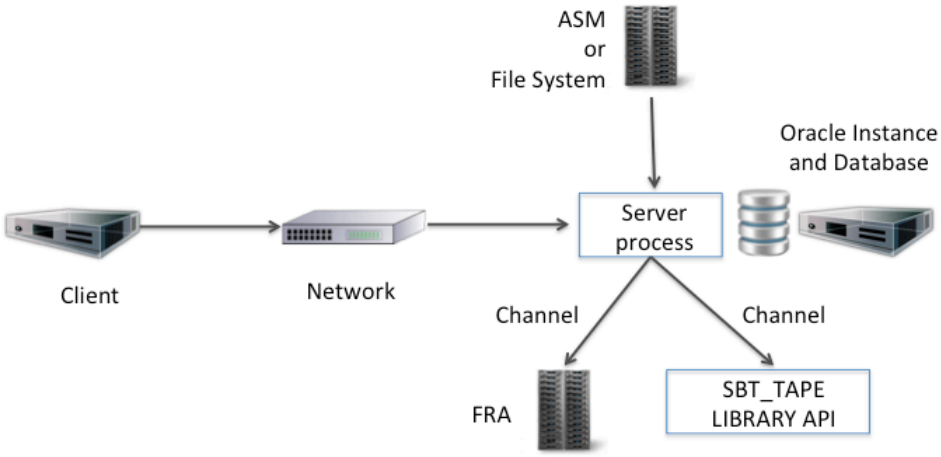

Illustration. 1: Recovery Manager schema

Recovery Manager performs I/O operations using channels. Each channel is assigned to an additional Oracle dedicated process. This process is reading data from data files and sending to output data stream. An Oracle database supports two types of output data streams:

- disk
- sbt_tape – an library with well defined API which can be provided by a 3rd party

RMAN script can define a channel or a default channel will be used. If a channel is defined as a disk type, output data stream will be saved into a file system accessible from a database server. If channel is defined as a sbt_tape type, a 3rd party library has be in installed and this library will redirect a data stream into a Media Manager server, backup appliance or cloud. This is a clearer solution as changing the data stream's location doesn't require a change in the backup script.

RMAN connection

Recovery Manager client uses local or SQL*Net connectivity. Here are connectivity examples:

Local connection

```
[oracle@linuxtarget ~]$ rman target /
Recovery Manager: Release 12.1.0.2.0 - Production on Sat Sep 24
17:58:26 2016
```

```
Copyright (c) 1982, 2014, Oracle and/or its affiliates.  All rights
reserved.
connected to target database: RMANTEST (DBID=3937007440)
RMAN>
```

Remote connection

```
[oracle@linuxtarget ~]$ rman target sys/oracle@rmantest
Recovery Manager: Release 12.1.0.2.0 - Production on Sat Sep 24
18:07:08 2016
Copyright (c) 1982, 2014, Oracle and/or its affiliates.  All rights
reserved.
connected to target database: RMANTEST (DBID=3937007440)
RMAN>
```

When connection is established, there will be one coordination process and one channel process.

```
20:09:59 SYS @ rmantest:>select sid, serial# from v$session where
program like 'rman%';

       SID    SERIAL#
---------- ----------
       266 27553
       269 15497
```

Basic RMAN backup

Full database backup should have three parts:

- database backup
- archive log backup at least for a time of database backup plus one
- control file backup

If a Fast Recovery Area is configured, an Oracle database uses it as a default location for all backups executed by Recovery manager. After successful connection, the easiest command to run is “backup database” to perform a backup of database using the default settings.

```
RMAN> backup database;

Starting backup at 24-SEP-16
using channel ORA_DISK_1
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00001
name=/u01/oradata/rmantest/system01.dbf
…
channel ORA_DISK_1: starting piece 1 at 24-SEP-16
channel ORA_DISK_1: finished piece 1 at 24-SEP-16
piece
handle=/u01/app/oracle/fast_recovery_area/RMANTEST/backupset/2016_09
```

```
_24/o1_mf_nnndf_TAG20160924T181151_cyfdyr20_.bkp
tag=TAG20160924T181151 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
…
Finished backup at 24-SEP-16
```

In the next step an archive log backup should be performed. There is a command to do it “backup archivelog all”

```
RMAN> backup archivelog all;

Starting backup at 28-SEP-16
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=9 RECID=7 STAMP=923776569
channel ORA_DISK_1: starting piece 1 at 28-SEP-16
…
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 28-SEP-16
```

The last step is a control file backup and this time it’s good to add a tag to have a easier way to identify a backup set name.

```
RMAN> backup current controlfile tag 'controlfile';

Starting backup at 28-SEP-16
using channel ORA_DISK_1
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
including current control file in backup set
channel ORA_DISK_1: starting piece 1 at 28-SEP-16
…
handle=/u01/app/oracle/fast_recovery_area/RMANTEST/backupset/2016_09
_28/o1_mf_ncnnf_CONTROLFILE_cyr730vl_.bkp tag=CONTROLFILE
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 28-SEP-16
```

Basic RMAN restore

The only one prerequisite to restore an Oracle database from backup, is an Oracle instance in nomount state. Script showed below required a name of control file backup and it will perform all steps automatically

```
run {
  restore controlfile from
'/u01/app/oracle/fast_recovery_area/RMANTEST/backupset/2016_09_28/o1
_mf_ncnnf_CONTROLFILE_cyr730vl_.bkp';
  alter database mount;
  restore database;
  recover database;
}
```

Here is a tailored output

```
[oracle@linuxtarget ~]$ rlwrap rman target /
Recovery Manager: Release 12.1.0.2.0 - Production on Wed Sep 28
20:44:07 2016
Copyright (c) 1982, 2014, Oracle and/or its affiliates.  All rights
reserved.
connected to target database: RMANTEST (not mounted)
RMAN> run {
2> restore controlfile from
'/u01/app/oracle/fast_recovery_area/RMANTEST/backupset/2016_09_28/o1
_mf_ncnnf_CONTROLFILE_cyr730vl_.bkp';
3> alter database mount;
4> restore database;
5> recover database;
6> }

Starting restore at 28-SEP-16
channel ORA_DISK_1: SID=12 device type=DISK

channel ORA_DISK_1: restoring control file
channel ORA_DISK_1: restore complete, elapsed time: 00:00:01
output file name=/u01/oradata/rmantest/control01.ctl
output file
name=/u01/app/oracle/fast_recovery_area/rmantest/control02.ctl
Finished restore at 28-SEP-16

Statement processed
released channel: ORA_DISK_1

Starting restore at 28-SEP-16
Starting implicit crosscheck backup at 28-SEP-16
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=12 device type=DISK
Crosschecked 5 objects
Finished implicit crosscheck backup at 28-SEP-16
```

```
Starting implicit crosscheck copy at 28-SEP-16
using channel ORA_DISK_1
Finished implicit crosscheck copy at 28-SEP-16

searching for all files in the recovery area
cataloging files...
cataloging done

List of Cataloged Files
=======================
File Name:
/u01/app/oracle/fast_recovery_area/RMANTEST/backupset/2016_09_28/o1_
mf_ncnnf_CONTROLFILE_cyr730vl_.bkp

using channel ORA_DISK_1

channel ORA_DISK_1: starting datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from backup
set
channel ORA_DISK_1: restoring datafile 00001 to
/u01/oradata/rmantest/system01.dbf
channel ORA_DISK_1: restoring datafile 00003 to
/u01/oradata/rmantest/sysaux01.dbf
channel ORA_DISK_1: restoring datafile 00004 to
/u01/oradata/rmantest/undotbs01.dbf
channel ORA_DISK_1: restoring datafile 00006 to
/u01/oradata/rmantest/users01.dbf
channel ORA_DISK_1: reading from backup piece
/u01/app/oracle/fast_recovery_area/RMANTEST/backupset/2016_09_28/o1_
mf_nnndf_TAG20160928T203534_cyr6w6m9_.bkp
channel ORA_DISK_1: piece
handle=/u01/app/oracle/fast_recovery_area/RMANTEST/backupset/2016_09
_28/o1_mf_nnndf_TAG20160928T203534_cyr6w6m9_.bkp
tag=TAG20160928T203534
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:07
Finished restore at 28-SEP-16

Starting recover at 28-SEP-16
using channel ORA_DISK_1

starting media recovery

archived log for thread 1 with sequence 9 is already on disk as file
/u01/app/oracle/fast_recovery_area/RMANTEST/archivelog/2016_09_28/o1
_mf_1_9_cyr6x94b_.arc
archived log file
name=/u01/app/oracle/fast_recovery_area/RMANTEST/archivelog/2016_09_
28/o1_mf_1_9_cyr6x94b_.arc thread=1 sequence=9
unable to find archived log
```

```
archived log thread=1 sequence=10
RMAN-00571:
===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS
===============
RMAN-00571:
===========================================================
RMAN-03002: failure of recover command at 09/28/2016 20:45:01
RMAN-06054: media recovery requesting unknown archived log for
thread 1 with sequence 10 and starting SCN of 1886676

RMAN>
```

The last line of output is an error. It doesn't look great but this is an expected error, as there is no more archive logs to apply. The simplest script showed above doesn't have any condition, which is a last archive log to apply, so it was applying logs until next log wasn't found.
After recovery is completed the very last step is to open a database using a reset log option.

```
RMAN> alter database open resetlogs;
Statement processed

RMAN> select status from v$instance;
STATUS
------------
OPEN
```

The example showed above is a simplest possible scenario for backup and recovery using an Oracle Recovery Manager. Other examples will be included in Power Point presentation and presented during session.

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