

RMAN recipes for disaster

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Tuomas Pystynen, Miracle Finland

Who am I

- Database consultant
Miracle Finland 2008 (founder)
Deepbase Consulting 1998
- Oracle Corporation
RMAN Development
Oracle7 testing
- Oracle Finland
- Oaktable member

Have a disaster recovery plan

- Gather business requirements

Recovery Time Objective RTO

Recovery Point Objective RPO (data loss)

- Identify potential risks

Human error, software bug, hardware failure,
natural disaster

- Plan preventive and corrective measures

monitoring, backups, standby databases,

Be prepared

- Plan backup and recovery strategy carefully
- Schedule and monitor regular backups
- Test, document and practise recovery procedures

Backup considerations

- Backup media

Disk, SAN or NAS (dNFS works well)

Tape, 3rd party MML with RMAN support (SBT)

- Backup and restore speed is important

must apply all redo generated during backup

- Incremental backups

faster and smaller than full backups

- **NOLOGGING** operations can not be recovered using redo logs

Backup script example

```
rman target=/ << EOF > $BACKUP_DIR/backup_database_${ORACLE_SID}.log

set echo on;

# set defaults
configure controlfile autobackup on;
configure controlfile autobackup format for device type disk to '$BACKUP_DIR/cf_%F';
configure snapshot controlfile name to '+DATA/$DB_NAME/controlfile/snapcf';
configure device type disk backup type to compressed backupset;
configure compression algorithm 'LOW'; # requires ACO license!
configure device type disk parallelism 8; # requires Enterprise Edition
show all;

# delete old archive logs and backups
delete noprompt backup completed before 'sysdate-7';
delete noprompt archivelog all completed before 'sysdate-7';

# backup database
backup filesperset 1 section size 32G format '$BACKUP_DIR/db_%d_%N_%T_%s_%p' database;

# backup all archivelogs
backup format '$BACKUP_DIR/al_%d_%h_%e_%T_%s' archivelog all not backed up;

exit

EOF
```

Monitor backups

```
rem RMAN records only successfully completed backups in the controlfile
```

```
rem check how old is the last backup of datafile 1
```

```
SQL> select (sysdate - max(completion_time)) days_old from v$backup_datafile where file#  
= 1;
```

```
DAYS_OLD
```

```
-----  
.015474537
```

```
rem check how old is the last archivelog backup
```

```
SQL> select (sysdate - max(next_time)) days_old from v$backup_redolog;
```

```
DAYS_OLD
```

```
-----  
.007175926
```

Backup maintenance

- Delete old backups and archive logs
 - using delete completed before command
 - using delete obsolete and retention policy
 - using retention/deletion policy and FRA
- Ensure `control_file_record_keep_time` is longer than retention time
- Test and monitor to ensure that deletion works as expected
 - monitor free disk space or tape capacity

Recovery catalog

- Recovery catalog makes certain recovery operations easier
especially when controlfile is damaged or lost
- Recovery catalog is useful
when backups are retained for a long time
tablespaces are created and dropped frequently
in Data Guard standby database configurations (11g)
- When not using Recovery catalog
backup controlfile frequently

Test and practise recovery

- Duplicate database is a good test for backups
checks that backups exist and can be restored
- Document recovery procedures
at least basic recovery cases
real-life situations are usually more complex
- Practise recovery regularly
real cases happen too seldom

Prerequisites for recovery

- A database server
with Oracle installed
- Disk space for restore
- Backups of datafiles and archivelogs
- Information for creating or restoring
parameter file
controlfile

When a problem occurs

- Diagnose the problem first
 - is the database still running?
 - are some files damaged or corrupt?
 - is some data missing or logically corrupt?
 - check alert logs and trace files

Data Recovery Advisor

```
# RMAN Data Recovery Advisor
```

Lists failures recorded by the Data Recovery Advisor. The database to which RMAN is connected **must be a single-instance database and must not be a physical standby database**. The Data Recovery Advisor can detect and repair a wide variety of physical problems that cause data loss and corruption. Physical corruptions are typically caused by faulty I/O subsystems or human error. The Data Recovery Advisor may not detect or handle some types of logical corruptions. Corruptions of this type require help from Oracle Support Services.

```
RMAN> list failure detail;
```

Failure ID	Priority	Status	Time Detected	Summary
146682	HIGH	OPEN	2012.11.19 20:00:18	One or more non-system datafiles are missing Impact: See impact for individual child failures List of child failures for parent failure ID 146682
146685	HIGH	OPEN	2012.11.19 20:00:18	Datafile 4: '/u01/oradata/TEST11/users01.dbf' is missing Impact: Some objects in tablespace USERS might be unavailable

Data Recovery Advisor

```
RMAN> advise failure 146682;
```

```
...
```

```
Optional Manual Actions
```

```
=====
```

```
If file /u01/oradata/TEST11/users01.dbf was unintentionally renamed or moved, restore it
```

```
Automated Repair Options
```

```
=====
```

```
Option Repair Description
```

```
-----
```

```
1      Restore and recover datafile 4
```

```
Strategy: The repair includes complete media recovery with no data loss
```

```
Repair script: /u01/app/diag/rdbms/test11/TEST11/hm/reco_3549534623.hm
```

```
# restore and recover datafile
```

```
sql 'alter database datafile 4 offline';
```

```
restore datafile 4;
```

```
recover datafile 4;
```

```
sql 'alter database datafile 4 online';
```

Diagnose problem 1

```
# check instance and database status
```

```
SQL> select host_name, status, startup_time from gv$instance;
```

HOST_NAME	STATUS	STARTUP_TIME
ip-10-54-38-226	OPEN	2012.11.19 19:37:51

```
# check controlfiles
```

```
SQL> select name, status from v$controlfile;
```

NAME	STATUS
/u01/oradata/TEST11/control01.ctl	
/u01/flash_recovery_area/TEST11/control02.ctl	

```
# check online redo logfiles
```

```
SQL> select member, status from v$logfile order by group#;
```

MEMBER	STATUS
/u01/oradata/TEST11/redo01.log	
/u01/oradata/TEST11/redo02.log	
/u01/oradata/TEST11/redo03.log	

Diagnose problem 2

check datafile status

SQL> select file#, name, status, error from v\$datafile_header;

FILE#	NAME	STATUS	ERROR
1	/u01/oradata/TEST11/system01.dbf	ONLINE	
2	/u01/oradata/TEST11/sysaux01.dbf	ONLINE	
4		ONLINE	CANNOT OPEN FILE
5	/u01/oradata/TEST11/example01.dbf	ONLINE	
6	/data1/oradata/TEST11/tbs_physical.dbf	ONLINE	
7	/data1/oradata/TEST11/tbs_logical.dbf	ONLINE	
8	/data1/oradata/TEST11/tbs_lost.dbf	ONLINE	
9	/u01/oradata/TEST11/opera_dw_data.dbf	ONLINE	
10	/u01/oradata/TEST11/hwsbw_data.dbf	ONLINE	
11	/u01/oradata/TEST11/undotbs.dbf	ONLINE	

10 rows selected.

check corrupt blocks

SQL> select * from v\$database_block_corruption;

FILE#	BLOCK#	BLOCKS	CORRUPTION_CHANGE#	CORRUPTIO
7	7	5	1585446	NOLOGGING

Controlfile corruption example

```
# A RAC database crashed with this error in the alert log
```

```
***** ATTENTION: *****  
The controlfile header block returned by the OS  
has a sequence number that is too old.  
The controlfile might be corrupted.  
PLEASE DO NOT ATTEMPT TO START UP THE INSTANCE  
without following the steps below.  
RE-STARTING THE INSTANCE CAN CAUSE SERIOUS DAMAGE  
TO THE DATABASE, if the controlfile is truly corrupted.  
In order to re-start the instance safely,  
please do the following:  
(1) Save all copies of the controlfile for later  
analysis and contact your OS vendor and Oracle support.  
(2) Mount the instance and issue:  
ALTER DATABASE BACKUP CONTROLFILE TO TRACE;  
(3) Unmount the instance.  
(4) Use the script in the trace file to  
RE-CREATE THE CONTROLFILE and open the database.  
*****  
CKPT (ospid: 27787362): terminating the instance
```

```
# The solution was to restore the controlfile from the latest autobackup,  
# recover database and open database.
```

Choose recovery procedure

- Typical recovery procedures

block recovery

datafile or tablespace recovery

complete database recovery

database point-in-time recovery

tablespace point-in-time recovery

restore a duplicate database (to point-in-time)

flashback database

Check available backups

- Check that necessary backups are available
avoid wasting time
- Complete recovery needs
all archived logs since the backup and
all online redo logs
- Point-in-time recovery needs
datafile backups taken before the point-in-time
all archived logs until the point-in-time

List available backups

RMAN> list backup of database completed after 'sysdate - 1';

BS Key	Type	LV	Size	Device	Type	Elapsed Time	Completion Time
113	Full		2.16M	DISK		00:00:01	2012.11.22 20:43:22
BP Key: 113 Status: AVAILABLE Compressed: YES Tag: TAG20121122T204059							
Piece Name: /data2/backup/df_TEST11_USERS_4_20121122_151							
List of Datafiles in backup set 113							
File	LV	Type	Ckp	SCN	Ckp Time	Name	
4		Full	5663918		2012.11.22 20:43:21	/u01/oradata/TEST11/users01.dbf	

RMAN> list backup of archivelog from time 'sysdate - 1';

BS Key	Size	Device	Type	Elapsed Time	Completion Time
122	20.74M	DISK		00:00:09	2012.11.22 20:44:07
BP Key: 122 Status: AVAILABLE Compressed: YES Tag: TAG20121122T204358					
Piece Name: /data2/backup/al_TEST11_1142_20121122_160					

List of Archived Logs in backup set 122

Thrd	Seq	Low SCN	Low Time	Next SCN	Next Time
1	1140	5405099	2012.11.22 20:20:31	5524487	2012.11.22 20:28:45
1	1141	5524487	2012.11.22 20:28:45	5642897	2012.11.22 20:38:01
1	1142	5642897	2012.11.22 20:38:01	5670387	2012.11.22 20:43:56

Latest backups

```
# select latest full backup of each datafile
SQL> select bdf.file#, bdf.checkpoint_change#, bdf.checkpoint_time, bdf.completion_time,
absolute_fuzzy_change#
  2  from v$backup_datafile bdf
  3  where bdf.checkpoint_change# =
  4    (select max(bdf2.checkpoint_change#)
  5    from v$backup_datafile bdf2
  6    where bdf2.file# = bdf.file# and bdf2.creation_change# = bdf.creation_change#
  7    and bdf2.incremental_change# <= bdf2.creation_change#)
  8  and bdf.creation_change# =
  9    (select max(df.creation_change#)
 10    from v$datafile df
 11    where df.file# = bdf.file#) order by bdf.file#;
```

FILE#	CHECKPOINT_SCN	CHECKPOINT_TIME	COMPLETION_TIME	FUZZY_SCN
1	5646195	2012.11.22 20:41:00	2012.11.22 20:42:24	0
2	5656102	2012.11.22 20:42:25	2012.11.22 20:43:11	0
4	5663918	2012.11.22 20:43:21	2012.11.22 20:43:22	0
5	5665862	2012.11.22 20:43:31	2012.11.22 20:43:41	0
6	5669238	2012.11.22 20:43:51	2012.11.22 20:43:51	0
7	5669509	2012.11.22 20:43:52	2012.11.22 20:43:52	0
8	5669780	2012.11.22 20:43:54	2012.11.22 20:43:54	0
9	5668232	2012.11.22 20:43:47	2012.11.22 20:43:48	0
10	5668970	2012.11.22 20:43:50	2012.11.22 20:43:50	0
11	5664 537	2012.11.22 20:43:24	2012.11.22 20:43:27	5664 542

Save existing files

- Save existing files before doing restore especially online redo logs and controlfile do not overwrite files without backups

Restore parameter file

- If parameter file is lost or must create a new database instance

restore spfile from backups

or create parameter file manually

Spfile file restore

```
# restore spfile from autobackup
```

```
RMAN> startup force nomount; # startup without spfile
```

```
starting Oracle instance without parameter file for retrieval of spfile
```

```
RMAN> set dbid 1234567890;
```

```
RMAN> set controlfile autobackup format for device type disk to '/opt/backup/%F';
```

```
RMAN> restore spfile from autobackup;
```

```
RMAN> startup force nomount # restart with restored spfile
```

```
# check restored spfile parameters
```

```
SQL> select name, value from v$spparameter where isspecified = 'TRUE' order by name;
```

NAME	VALUE
.....
...	
control_files	/u01/oradata/TEST11/control01.ctl
control_files	/u01/flash_recovery_area/TEST11/control02.ctl
db_block_size	8192
db_create_file_dest	/u01/oradata
db_domain	
db_name	TEST11
db_recovery_file_dest	/u01/flash_recovery_area
...	

Restore controlfile

- If all controlfiles are lost or damaged
restore controlfile from a backup or
recreate controlfile
- When trying complete recovery
restore controlfile from latest backup
- When trying point-in-time recovery
restore controlfile from a backup taken near the
point-in-time

Controlfile restore

```
SQL> startup force nomount
SQL> show parameter control_files
```

NAME	TYPE	VALUE
control_files	string	/u01/oradata/TEST11/control01.ctl, /u01/flash_recovery_area/TEST11/control02.ctl

```
# restore controlfile
# if controlfile backup is in the latest autobackup
```

```
RMAN> set dbid 123456789;
RMAN> set controlfile autobackup format for device type disk to '/opt/backup/%F';
RMAN> restore controlfile from autobackup;
```

```
# if controlfile backup is in a known file
```

```
RMAN> restore controlfile from '/opt/backup/controlfile_backup.dbf';
```

Controlfile restore from tape

```
# restore controlfile from autobackup on tape

alter system set control_files='/oradata/database/TEST/control01.ctl' scope=spfile;

startup force nomount

set dbid=1234567890;
set controlfile autobackup format for device type sbt to 'CONTROLFILE.PROD.%F';
run {
allocate channel c0 type sbt PARMS="SBT_LIBRARY=/usr/local/avamar/lib/libobk_avamar64.so"
format '%d_%U';
send channel 'c0' '"--prefix=11g/HOT/" "--flagfile=/home/oracle/my-avtar-flags.txt" "--
bindir=/usr/local/avamar/bin" "--logfile=/tmp/restore.log"';
restore controlfile from autobackup MAXSEQ=00;
release channel c0;
}
```

Recreate controlfile

generate create controlfile statement to a file before hand

SQL> **alter database backup controlfile to trace as '/tmp/recreate_cf.sql' noresetlogs;**

```
CREATE CONTROLFILE REUSE DATABASE "TEST11" NORESETLOGS ARCHIVELOG
  MAXLOGFILES 16
  MAXLOGMEMBERS 3
  MAXDATAFILES 100
  MAXINSTANCES 8
  MAXLOGHISTORY 697
LOGFILE
  GROUP 1 '/u01/oradata/TEST11/redo01.log' SIZE 50M BLOCKSIZE 512,
  GROUP 2 '/u01/oradata/TEST11/redo02.log' SIZE 50M BLOCKSIZE 512,
  GROUP 3 '/u01/oradata/TEST11/redo03.log' SIZE 50M BLOCKSIZE 512
DATAFILE
  '/u01/oradata/TEST11/system01.dbf',
  '/u01/oradata/TEST11/sysaux01.dbf',
  '/u01/oradata/TEST11/users01.dbf',
  '/u01/oradata/TEST11/example01.dbf',
  '/data1/oradata/TEST11/tbs_physical.dbf',
  '/data1/oradata/TEST11/tbs_logical.dbf',
  '/data1/oradata/TEST11/tbs_lost.dbf',
  '/u01/oradata/TEST11/opera_dw_data.dbf',
  '/u01/oradata/TEST11/hwsbw_data.dbf',
  '/u01/oradata/TEST11/undotbs.dbf'
CHARACTER SET WE8MSWIN1252;
```

Check and fix controlfile

- Check the restored controlfile
mount the database first
- Check datafile names
use set newname to restore to another location
- Check backups
catalog missing backups needed for recovery
- Check archive logs
catalog missing archive logs needed for recovery

Check controlfile

rem check that logfile and datafile entries point to correct location

```
SQL> select group#, member from v$logfile order by group#;
```

```
GROUP# MEMBER
```

```
-----  
1 /u01/oradata/TEST11/redo01.log  
2 /u01/oradata/TEST11/redo02.log  
3 /u01/oradata/TEST11/redo03.log
```

```
SQL> select file#, name, status from v$datafile;
```

```
FILE# NAME
```

```
STATUS
```

```
-----  
1 /u01/oradata/TEST11/system01.dbf SYSTEM  
2 /u01/oradata/TEST11/sysaux01.dbf ONLINE  
3 /u01/oradata/TEST11/tbs_physical.dbf ONLINE  
4 /u01/oradata/TEST11/users01.dbf ONLINE  
5 /u01/oradata/TEST11/example01.dbf ONLINE  
6 /u01/oradata/TEST11/tbs_logical.dbf ONLINE  
7 /u01/oradata/TEST11/tbs_offline.dbf OFFLINE  
8 /u01/oradata/TEST11/tbs_onoff.dbf OFFLINE  
9 /u01/oradata/TEST11/tbs_readonly.dbf ONLINE  
10 /u01/oradata/TEST11/tbs_skip.dbf ONLINE  
11 /u01/oradata/TEST11/undotbs.dbf ONLINE  
12 /u01/oradata/TEST11/datafile/o1_mf_tbs_omf_8cdv8n5h_.dbf ONLINE  
13 /u01/oradata/TEST11/tbs_old.dbf ONLINE  
14 /u01/oradata/TEST11/tbs_incremental.dbf ONLINE
```

Check controlfile

```
RMAN> list backup of database completed after 'sysdate - 1';
```

```
BS Key   Type LV Size          Device Type Elapsed Time Completion Time
-----
140      Full  1.27G          DISK              00:01:01      2012.11.28 22:01:01
      BP Key: 140      Status: AVAILABLE Compressed: NO   Tag: TAG20121128T215959
      Piece Name: /data2/backup/db_backup_1
File LV Type Ckp SCN      Ckp Time          Name
---- -- ---
1      Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/system01.dbf
2      Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/sysaux01.dbf
3      Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/tbs_physical.dbf
4      Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/users01.dbf
5      Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/example01.dbf
6      Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/tbs_logical.dbf
7      Full 6136052      2012.11.28 21:59:51 /u01/oradata/TEST11/tbs_offline.dbf
8      Full 6136067      2012.11.28 21:59:51 /u01/oradata/TEST11/tbs_onoff.dbf
9      Full 6136078      2012.11.28 21:59:51 /u01/oradata/TEST11/tbs_readonly.dbf
10     Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/tbs_skip.dbf
11     Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/undotbs.dbf
12     Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/datafile/o1_mf_tbs_omf.
13     Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/tbs_old.dbf
14     Full 6136114      2012.11.28 22:00:00 /u01/oradata/TEST11/tbs_incremental.dbf
```

```
RMAN> list backup of archivelog from time 'sysdate - 1';
specification does not match any backup in the repository
```

Catalog missing backups

```
RMAN> catalog backuppiece '/data2/backup/al_backup_2';
```

```
cataloged backup piece
```

```
backup piece handle=/data2/backup/al_backup_2 RECID=143 STAMP=800577231
```

```
RMAN> list backup of archivelog from time 'sysdate - 1';
```

```
BS Key   Size          Device Type Elapsed Time Completion Time
```

```
-----  
143      17.67M        DISK          00:00:00      2012.11.28 22:05:52  
BP Key: 143   Status: AVAILABLE Compressed: NO   Tag: TAG20121128T220551  
Piece Name: /data2/backup/al_backup_2  
Thrd Seq      Low SCN      Low Time          Next SCN      Next Time  
-----  
1     1237      6134781      2012.11.28 21:57:42      6136120      2012.11.28 22:00:01  
1     1238      6136120      2012.11.28 22:00:01      6136247      2012.11.28 22:01:00  
1     1239      6136247      2012.11.28 22:01:00      6136346      2012.11.28 22:02:01  
1     1240      6136346      2012.11.28 22:02:01      6136412      2012.11.28 22:03:01  
1     1241      6136412      2012.11.28 22:03:01      6136489      2012.11.28 22:04:01  
1     1242      6136489      2012.11.28 22:04:01      6136602      2012.11.28 22:05:00  
1     1243      6136602      2012.11.28 22:05:00      6136724      2012.11.28 22:05:50
```


Restore datafiles

- RMAN decides which backups to use usually the latest backup of each datafile
point-in-time recovery uses backups taken before
can use tags, device type to influence selection
- RMAN can use only backups listed in control file or recovery catalog
- By default datafiles are restored to location recorded in the controlfile
can use set newname to override location
OMF datafiles may get a new name

Restore datafile

```
SQL> select bdf.file#, bdf.checkpoint_change#, bdf.checkpoint_time, bdf.completion_time,
absolute_fuzzy_change# from v$backup_datafile bdf where file# = 4;
```

FILE#	CHECKPOINT_SCN	CHECKPOINT_TIME	COMPLETION_TIME	FUZZY_SCN
4	5399256	2012.11.22 20:19:59	2012.11.22 20:19:59	0
4	5663918	2012.11.22 20:43:21	2012.11.22 20:43:22	0

```
# try to restore to point-in-time before the first backup, fails
RMAN> restore tablespace users until time '2012.11.22 20:00:00';
```

```
RMAN-06023: no backup or copy of datafile 4 found to restore
```

```
# restore to point-in-time between the backups, uses first backup
RMAN> restore tablespace users until time '2012.11.22 20:30:00';
```

```
channel ORA_DISK_1: restoring datafile 00004 to /u01/oradata/TEST11/users01.dbf
channel ORA_DISK_1: reading from backup piece /data2/backup/df_TEST11_USERS_4_20121122_13
```

```
# restore to current time, uses last backup
RMAN> restore tablespace users;
```

```
channel ORA_DISK_1: restoring datafile 00004 to /u01/oradata/TEST11/users01.dbf
channel ORA_DISK_1: reading from backup piece /data2/backup/df_TEST11_USERS_4_20121122_15
```

Restore datafile

```
# restore datafile from a specified backup set
RMAN> restore tablespace users from tag 'TAG20121122T201738';

channel ORA_DISK_1: restoring datafile 00004 to /u01/oradata/TEST11/users01.dbf
channel ORA_DISK_1: reading from backup piece /data2/backup/df_TEST11_USERS_4_20121122_13

# try to restore datafile from a tape backup, does not exist
RMAN> restore tablespace users device type sbt_tape;

channel ORA_SBT_TAPE_1: WARNING: Oracle Test Disk API

RMAN-06100: no channel to restore a backup or copy of datafile 4

# restore datafile to a new location
RMAN> run {
  set newname for datafile 4 to '/u01/oradata/TEST11/users01_new.dbf';
  restore tablespace users;
  switch datafile 4;
}

channel ORA_DISK_1: restoring datafile 00004 to /u01/oradata/TEST11/users01_new.dbf
channel ORA_DISK_1: reading from backup piece /data2/backup/df_TEST11_USERS_4_20121122_15
datafile 4 switched to datafile copy
```

Restore database

```
RMAN> restore database skip tablespace tbs_skip;
```

```
Starting restore at ...
```

```
allocated channel: ORA_DISK_1
```

```
creating datafile file number=13 name=/u01/oradata/TEST11/tbs_new.dbf
```

```
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 00007 to /u01/oradata/TEST11/tbs_offline.dbf
```

```
channel ORA_DISK_1: restoring datafile 00008 to /u01/oradata/TEST11/tbs_onoff.dbf
```

```
channel ORA_DISK_1: restoring datafile 00009 to /u01/oradata/TEST11/tbs_readonly.dbf
```

```
channel ORA_DISK_1: reading from backup piece /data2/backup/db_backup_1
```

```
channel ORA_DISK_1: piece handle=/data2/backup/db_backup_1 tag=TAG20121130T230829
```

```
channel ORA_DISK_1: restore complete, elapsed time: 00:00:25
```

```
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/TEST11/system01.dbf
```

```
channel ORA_DISK_1: restoring datafile 00002 to /u01/oradata/TEST11/sysaux01.dbf
```

```
channel ORA_DISK_1: restoring datafile 00003 to /u01/oradata/TEST11/tbs_physical.dbf
```

```
channel ORA_DISK_1: restoring datafile 00004 to /u01/oradata/TEST11/users01.dbf
```

```
channel ORA_DISK_1: restoring datafile 00005 to /u01/oradata/TEST11/example01.dbf
```

```
channel ORA_DISK_1: restoring datafile 00006 to /u01/oradata/TEST11/tbs_logical.dbf
```

```
channel ORA_DISK_1: restoring datafile 00011 to /u01/oradata/TEST11/undotbs.dbf
```

```
channel ORA_DISK_1: reading from backup piece /data2/backup/db_backup_2
```

```
channel ORA_DISK_1: piece handle=/data2/backup/db_backup_2 tag=TAG20121130T231258
```

```
channel ORA_DISK_1: restore complete, elapsed time: 00:01:15
```

Restore monitoring

- Restore usually takes longer than backup
many hours when restoring a large database
time depends on many factors
- Can monitor the progress of restore
using `v$session_longops` or `v$rman_status`

RMAN monitoring

```
RMAN> backup tablespace users;
```

```
2>
```

```
Starting backup at 16-APR-12
```

```
using target database control file instead of recovery catalog
```

```
allocated channel: ORA_DISK_1
```

```
channel ORA_DISK_1: SID=38 device type=DISK
```

```
channel ORA_DISK_1: starting compressed full datafile backup set
```

```
channel ORA_DISK_1: specifying datafile(s) in backup set
```

```
input datafile file number=00004 name=/u01/oradata/TEST11/users01.dbf
```

```
channel ORA_DISK_1: starting piece 1 at 16-APR-12
```

```
SQL> select sid, module, action, client_info from v$session where program like 'rman%';
```

SID	MODULE	ACTION	CLIENT_INFO
38	backup full datafile	0000018 STARTED16	rman channel=ORA_DISK_1
41	rman@ip-10-226-234-111 (TNS V1-V3)	0000003 FINISHED66	
55	rman@ip-10-226-234-111 (TNS V1-V3)		

```
SQL> select sid, message, time_remaining from v$session_longops where sofar < totalwork;
```

SID	MESSAGE	TIME_REMAINING
41	RMAN: aggregate input: backup 33: 382078 out of 870080 Blocks done	469
38	RMAN: full datafile backup: Set Count 93: 419070 out of 870080 Blocks done	434

RMAN wait events

```
SQL> select event, 10*time_waited total_time, total_waits, 10*time_waited/total_waits
avg_wait, 10*max_wait max_wait
  2  from v$session_event
  3  where sid = &1
  4  union
  5  select stat_name, value/1000, null, null, null
  6  from v$sess_time_model
  7  where sid = &1
  8  and value > 0
  9  order by 2 desc;
```

EVENT	TOTAL_TIME	TOTAL_WAITS	AVG_WAIT	MAX_WAIT
background elapsed time	43,121			
RMAN backup & recovery I/O	15,690	1485	10.6	70.0
SQL*Net message from client	11,170	58	192.6	9,340.0
RMAN cpu time (backup/restore)	1,320			
background cpu time	1,320			
control file sequential read	140	113	1.2	20.0
Disk file operations I/O	90	20	4.5	60.0

RMAN recover

- Recovers restored datafiles using
incremental backups
offline ranges
archived logs/online redo logs
- Applying incremental backups can also
recover **NOLOGGING** operations
no need to restore incremental backups
- Archived logs are restored as needed
can specify an alternate location for restore

Recovery

- Database must be mounted to perform database recovery
or open when recovering datafiles or tablespaces
database recovery will not recover offline files
- Recovery starts from the checkpoint SCN of each datafile
checkpoint SCN is advanced during recovery
- RMAN determines which archivelogs and incremental backups are needed

RMAN recovery example

```
RMAN> recover database skip tablespace tbs_skip;
```

```
allocated channel: ORA_DISK_1
```

```
datafile 9 not processed because file is read-only
```

```
applied offline range to datafile 00008
```

```
offline range RECID=16 STAMP=800576557
```

```
channel ORA_DISK_1: starting incremental datafile backup set restore
```

```
destination for restore of datafile 00014: /u01/oradata/TEST11/tbs_incremental.dbf
```

```
channel ORA_DISK_1: restore complete, elapsed time: 00:00:01
```

```
Executing: alter database datafile 10 offline
```

```
starting media recovery
```

```
archived log for thread 1 with sequence 1243 is already on disk as file /u01/flash_re...
```

```
channel ORA_DISK_1: starting archived log restore to default destination
```

```
channel ORA_DISK_1: restoring archived log
```

```
archived log thread=1 sequence=1242
```

```
channel ORA_DISK_1: restore complete, elapsed time: 00:00:01
```

```
archived log file name=/u01/flash_recovery_area/TEST11/archivelog/2012_11_28/  
01_mf_1_1242_8cdwzscv_.arc thread=1 sequence=1242
```

```
channel default: deleting archived log(s)
```

```
archived log file name=/u01/flash_recovery_area/TEST11/archivelog/2012_11_28/  
01_mf_1_1242_8cdwzscv_.arc RECID=656 STAMP=800576921
```

```
archived log file name=/u01/flash_recovery_area/TEST11/archivelog/2012_11_28/  
01_mf_1_1243_8cdwzs6x_.arc thread=1 sequence=1243
```

```
media recovery complete, elapsed time: 00:00:05
```

```
Finished recover at ...
```

Open database

- **Alter database open**
can be used when all redo has been applied
- **Alter database open NORESETLOGS**
used when using a backup controlfile and all redo has been applied. No longer needed/supported?
- **Alter database open RESETLOGS**
is needed after point-in-time recovery
database must be in a consistent state
will clear online redo logs!

Check database after recovery

- Check your data
especially NOLOGGING objects
- Check that tablespaces are online
offline tablespaces are not recovered
- Export and/or backup database
Full database export is a good validation of data
RMAN backup checks all blocks it reads