



SKILLBUILDERS

Oracle 10g Feature: RMAN Incrementally Updated Backups

Author: Dave Anderson, SkillBuilders

Date: September 13, 2004

Introduction

This article explains one of the features presented by Dave Anderson at the September 21 NYOUG meeting in the presentation “Oracle10g New Features for DBA’s”.

Audience

This article is intended for Oracle Administrators who are familiar with Oracle9i and RMAN.

Concepts

The RMAN Incrementally Updated Backup feature is designed to limit the amount of redo you will need to apply during recovery operations – *thus reduce recovery time*. The basic idea is to create image copies of your datafiles, then subsequently update the image copies with incremental backups, i.e. merge level 1 incremental backups (i.e. backupset pieces) into an existing image copy.

For the remainder of the article I will refer to the feature as “ICIU” – Image Copy Incremental Updates.

The concept for the following RMAN script comes from the *Oracle10g Backup and Recovery Basics* manual. In the script, we see two RMAN commands, the RECOVER COPY (new with 10g) and BACKUP. The BACKUP command contains a new clause, “FOR RECOVER OF COPY WITH TAG”. This tells RMAN to create an incremental to be used to recover an image copy.

```

RMAN> run {
2>  recover copy of database with tag 'ICIU1';
3>  backup
4>    incremental level 1 tag 'ICIU1'
5>    for recover of copy with tag 'ICIU1'
6>    database plus archivelog delete input;
7>  }
```

The script can be run daily. Each day this runs:

- ◆ The RECOVER COPY command updates each datafile image copy with the previous day's level 1 incremental. If it does not find an image copy to update or a level 1 to apply, the RECOVER command simply issues messages and successfully terminates.
- ◆ The BACKUP command creates a new level 1 incremental. However, if a level 0 image copy does not exist (e.g. on the 1st run), the BACKUP command will create one.

Thus, at all times, you have available for recovery:

- ◆ Image copy up to a maximum of 48 hours old
- ◆ Level 1 incremental up to a maximum of 24 hours old
- ◆ Online and archive logs to support point-in-time or complete recovery.

With this strategy, you will never have to apply more than 24 hours of redo (archive logs) to apply to perform a complete recovery.

The RECOVER COPY command will apply all level 1 incrementals to an image copy with the tag "ICIU". Note that an *identical* user-defined tag must be used on the RECOVER COPY command and the BACKUP FOR RECOVER OF COPY WITH TAG clause. Using a tag on the INCREMENTAL LEVEL 1 clause is optional, but I did not like the default tag RMAN supplied for the incrementals, so I supplied my own.

Note that the PLUS ARCHIVELOG DELETE INPUT is completely optional and not necessary for this example. I simply wanted to show that it could be used, as well as other options such as the 10g 'AS COMPRESSED BACKUPSET' option.

Example: 1st Run

I used a new database for these tests. You will see from the empty response from the LIST BACKUPSET command that there are currently no RMAN backupsets available.

On the 1st run of the ICIU script:

- ◆ The RECOVER command finds no image copies to update, so it issues message "no copy of datafile 1 found to recover" for each datafile and terminates.
- ◆ The BACKUP command realizes there is no level 0 image copy (see the message "no parent backup or copy of datafile 1 found") so it creates one for every datafile.

```
RMAN> list backupset ;
```

```
RMAN> run {
2>  recover copy of database with tag 'ICIU1';
3>  backup
4>     incremental level 1 tag 'ICIU1'
5>     for recover of copy with tag 'ICIU1'
6>     database plus archivelog delete input;
7> }
```

```
Starting recover at 11-SEP-04
using channel ORA_SBT_TAPE_1
```

```
using channel ORA_DISK_1
no copy of datafile 1 found to recover
no copy of datafile 2 found to recover
no copy of datafile 3 found to recover
no copy of datafile 4 found to recover
Finished recover at 11-SEP-04
```

```
Starting backup at 11-SEP-04
current log archived
released channel: ORA_SBT_TAPE_1
using channel ORA_DISK_1
channel ORA_DISK_1: starting archive log backupset
channel ORA_DISK_1: specifying archive log(s) in backup set
input archive log thread=1 sequence=232 recid=120 stamp=536522472
input archive log thread=1 sequence=233 recid=121 stamp=536533256
input archive log thread=1 sequence=234 recid=122 stamp=536536843
input archive log thread=1 sequence=235 recid=123 stamp=536536913
input archive log thread=1 sequence=236 recid=124 stamp=536537615
input archive log thread=1 sequence=237 recid=125 stamp=536540472
input archive log thread=1 sequence=238 recid=126 stamp=536551256
input archive log thread=1 sequence=239 recid=127 stamp=536562040
input archive log thread=1 sequence=240 recid=128 stamp=536565665
input archive log thread=1 sequence=241 recid=129 stamp=536570040
input archive log thread=1 sequence=242 recid=130 stamp=536573619
channel ORA_DISK_1: starting piece 1 at 11-SEP-04
channel ORA_DISK_1: finished piece 1 at 11-SEP-04
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_11/o1_mf_annnn_ICIU1_0n5tzosg_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:26
channel ORA_DISK_1: deleting archive log(s)
archive log filename=+ASM_DISK_GROUP1/orcl//1_232_535733210.dbf recid=120 stamp=536522472
archive log filename=+ASM_DISK_GROUP1/orcl//1_233_535733210.dbf recid=121 stamp=536533256
archive log filename=+ASM_DISK_GROUP1/orcl//1_234_535733210.dbf recid=122 stamp=536536843
archive log filename=+ASM_DISK_GROUP1/orcl//1_235_535733210.dbf recid=123 stamp=536536913
archive log filename=+ASM_DISK_GROUP1/orcl//1_236_535733210.dbf recid=124 stamp=536537615
archive log filename=+ASM_DISK_GROUP1/orcl//1_237_535733210.dbf recid=125 stamp=536540472
archive log filename=+ASM_DISK_GROUP1/orcl//1_238_535733210.dbf recid=126 stamp=536551256
archive log filename=+ASM_DISK_GROUP1/orcl//1_239_535733210.dbf recid=127 stamp=536562040
archive log filename=+ASM_DISK_GROUP1/orcl//1_240_535733210.dbf recid=128 stamp=536565665
archive log filename=+ASM_DISK_GROUP1/orcl//1_241_535733210.dbf recid=129 stamp=536570040
archive log filename=+ASM_DISK_GROUP1/orcl//1_242_535733210.dbf recid=130 stamp=536573619
Finished backup at 11-SEP-04
```

```
Starting backup at 11-SEP-04
```

```
using channel ORA_DISK_1
no parent backup or copy of datafile 1 found
no parent backup or copy of datafile 3 found
no parent backup or copy of datafile 2 found
no parent backup or copy of datafile 4 found
channel ORA_DISK_1: starting datafile copy
input datafile fno=00001 name=+ASM_DISK_GROUP1/orcl/datafile/system.264.1
output filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_system_0n5v011x_.dbf tag=ICIU1
recid=35 stamp=536573737
channel ORA_DISK_1: datafile copy complete, elapsed time: 00:01:35
channel ORA_DISK_1: starting datafile copy
input datafile fno=00003 name=+ASM_DISK_GROUP1/orcl/datafile/sysaux.266.1
output filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_sysaux_0n5v3kr6_.dbf tag=ICIU1
recid=36 stamp=536573807
channel ORA_DISK_1: datafile copy complete, elapsed time: 00:01:05
channel ORA_DISK_1: starting datafile copy
input datafile fno=00002 name=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.265.1
output filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_undotbs1_0n5v5v1m_.dbf tag=ICIU1
recid=37 stamp=536573860
channel ORA_DISK_1: datafile copy complete, elapsed time: 00:00:55
channel ORA_DISK_1: starting datafile copy
input datafile fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.268.1
output filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_users_0n5v79vp_.dbf tag=ICIU1
recid=38 stamp=536573867
channel ORA_DISK_1: datafile copy complete, elapsed time: 00:00:03
channel ORA_DISK_1: starting incremental level 1 datafile backupset
channel ORA_DISK_1: specifying datafile(s) in backupset
including current controlfile in backupset
including current SPFILE in backupset
channel ORA_DISK_1: starting piece 1 at 11-SEP-04
channel ORA_DISK_1: finished piece 1 at 11-SEP-04
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_11/o1_mf_ncsn1_ICIU1_0n5v7jvy_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
Finished backup at 11-SEP-04
```

```
Starting backup at 11-SEP-04
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting archive log backupset
channel ORA_DISK_1: specifying archive log(s) in backup set
input archive log thread=1 sequence=243 recid=131 stamp=536573876
channel ORA_DISK_1: starting piece 1 at 11-SEP-04
channel ORA_DISK_1: finished piece 1 at 11-SEP-04
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_11/o1_mf_annnn_ICIU1_0n5v7pcp_.bkp
comment=NONE
```

```
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:02
channel ORA_DISK_1: deleting archive log(s)
archive log filename=+ASM_DISK_GROUP1/orcl//1_243_535733210.dbf recid=131 stamp=536573876
Finished backup at 11-SEP-04
```

You can see from the references to “+ASM_DISK_GROUP1” in the input archive log and input datafile messages that I am using another Oracle10g new feature, “Automatic Storage Management”. I will cover that feature in a separate article – visit www.skillbuilders.com regularly for more 10g articles.

Finally, you may also notice that RMAN uses different target directories for the backupsets versus the image copies. Backupsets are put in:

- ◆ piece handle=/mnt/mickeymantle/ORCL/backupset/

Image copies of the datafiles are put in:

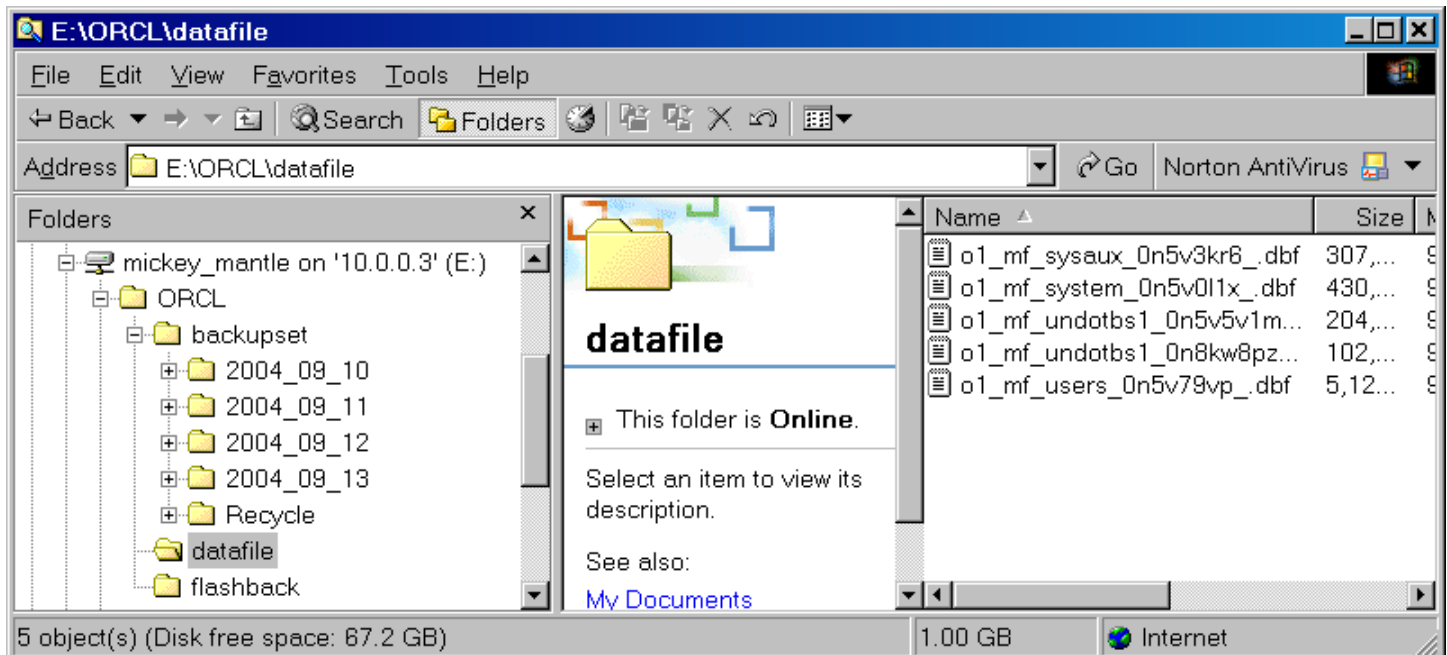
- ◆ output filename=/mnt/mickeymantle/ORCL/datafile/

Why is this? Well, two reasons. First, I am using another Oracle10g feature called the “Flash Recovery Area”. This is implemented via these parameters:

```
LINUX> show parameter db_reco
```

NAME	TYPE	VALUE
db_recovery_file_dest	string	/mnt/mickeymantle/
db_recovery_file_dest_size	big integer	2G

Secondly, because in 10g, the default location for RMAN disk-based backups is the “flash recovery area” – pointed to by parameter DB_RECOVERY_FILE_DEST. Here is a graphical representation of the directories created by RMAN in the flash recovery area (note that the Windows network drive map name is different from the LINUX mount point, but it is the same disk):



We see that RMAN creates an easy-to-navigate series of sub-directories for backups using the instance name “ORCL” followed by the file type (backupset, datafile or flashback). It even creates directories for the date the backupset was created. Oracle will automatically delete obsolete files (according to the configured retention policy) from the flash recovery area if the area fills up. (Note that the “flashback” directory is used by the flashback database feature if flashback mode is enabled.)

2nd Run

This second run using the ICIU strategy was run approximately 24 hours after the first run.

Note that the RECOVER COPY command still does not have any work to do (yet – not until the 3rd and subsequent runs). However, the messages issued by RECOVER are actually misleading in this case. This form of the RECOVER command is looking for level 1 backupsets to apply to datafile image copies (with the tag “ICIU”). We know that the image copies exist – I created them yesterday in “run 1”. We know that level 1 backups don’t exist yet – we will create them with the next command in this script. Yet the message says “no copy of datafile 1 found to recover”. Perhaps a more intuitive message would be “no level 1 backup found to recover image copy of datafile 1”.

You will see that I added a datafile (for the UNDO tablespace) prior to run 2 – the REPORT SCHEMA command shows the new, 5th datafile. The BACKUP command output reveals that RMAN finds an image copy for the original 4 files – thus creates a level 1 incremental for those files – but does not find an image copy for the new datafile, thus creates the level 0 image copy for that file.

```
RMAN> report schema;
```

```
Report of database schema
```

File	K-bytes	Tablespace	RB	segs	Datafile Name
1	430080	SYSTEM	***		+ASM_DISK_GROUP1/orcl/datafile/system.264.1
2	204800	UNDOTBS1	***		+ASM_DISK_GROUP1/orcl/datafile/undotbs1.265.
3	307200	SYSAUX	***		+ASM_DISK_GROUP1/orcl/datafile/sysaux.266.1
4	5120	USERS	***		+ASM_DISK_GROUP1/orcl/datafile/users.268.1
5	102400	UNDOTBS1	***		+ASM_DISK_GROUP1/orcl/datafile/undotbs1.295.17

```
RMAN> run {
2> recover copy of database with tag 'ICIU1';
3> backup
4>   incremental level 1 tag 'ICIU1'
5>   for recover of copy with tag 'ICIU1'
6>   database plus archivelog delete input;
7> }
```

```
Starting recover at 12-SEP-04
allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: sid=247 devtype=SBT_TAPE
channel ORA_SBT_TAPE_1: NMO v4.1.0.0
```

```
using channel ORA_DISK_1
no copy of datafile 1 found to recover
no copy of datafile 2 found to recover
no copy of datafile 3 found to recover
no copy of datafile 4 found to recover
no copy of datafile 5 found to recover
Finished recover at 12-SEP-04
```

```
Starting backup at 12-SEP-04
current log archived
released channel: ORA_SBT_TAPE_1
using channel ORA_DISK_1
channel ORA_DISK_1: starting archive log backupset
channel ORA_DISK_1: specifying archive log(s) in backup set
input archive log thread=1 sequence=244 recid=132 stamp=536583615
input archive log thread=1 sequence=245 recid=133 stamp=536590829
input archive log thread=1 sequence=246 recid=134 stamp=536601611
input archive log thread=1 sequence=247 recid=135 stamp=536612462
input archive log thread=1 sequence=248 recid=136 stamp=536622662
input archive log thread=1 sequence=249 recid=137 stamp=536627744
input archive log thread=1 sequence=250 recid=138 stamp=536631329
input archive log thread=1 sequence=251 recid=139 stamp=536641263
input archive log thread=1 sequence=252 recid=140 stamp=536652033
input archive log thread=1 sequence=253 recid=141 stamp=536662513
channel ORA_DISK_1: starting piece 1 at 12-SEP-04
channel ORA_DISK_1: finished piece 1 at 12-SEP-04
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_12/o1_mf_annnn_ICIU1_0n8ksol7_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:27
channel ORA_DISK_1: deleting archive log(s)
archive log filename=+ASM_DISK_GROUP1/orcl//1_244_535733210.dbf recid=132 stamp=536583615
archive log filename=+ASM_DISK_GROUP1/orcl//1_245_535733210.dbf recid=133 stamp=536590829
archive log filename=+ASM_DISK_GROUP1/orcl//1_246_535733210.dbf recid=134 stamp=536601611
archive log filename=+ASM_DISK_GROUP1/orcl//1_247_535733210.dbf recid=135 stamp=536612462
archive log filename=+ASM_DISK_GROUP1/orcl//1_248_535733210.dbf recid=136 stamp=536622662
archive log filename=+ASM_DISK_GROUP1/orcl//1_249_535733210.dbf recid=137 stamp=536627744
archive log filename=+ASM_DISK_GROUP1/orcl//1_250_535733210.dbf recid=138 stamp=536631329
archive log filename=+ASM_DISK_GROUP1/orcl//1_251_535733210.dbf recid=139 stamp=536641263
archive log filename=+ASM_DISK_GROUP1/orcl//1_252_535733210.dbf recid=140 stamp=536652033
archive log filename=+ASM_DISK_GROUP1/orcl//1_253_535733210.dbf recid=141 stamp=536662513
Finished backup at 12-SEP-04
```

```
Starting backup at 12-SEP-04
using channel ORA_DISK_1
```

no parent backup or copy of datafile 5 found

```
channel ORA_DISK_1: starting incremental level 1 datafile backupset
channel ORA_DISK_1: specifying datafile(s) in backupset
input datafile fno=00001 name=+ASM_DISK_GROUP1/orcl/datafile/system.264.1
input datafile fno=00003 name=+ASM_DISK_GROUP1/orcl/datafile/sysaux.266.1
input datafile fno=00002 name=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.265.1
input datafile fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.268.1
channel ORA_DISK_1: starting piece 1 at 12-SEP-04
channel ORA_DISK_1: finished piece 1 at 12-SEP-04
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_12/o1_mf_nnnd1_ICIU1_0n8kt15j_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:56
channel ORA_DISK_1: starting datafile copy <<<== Image copy of new datafile
input datafile fno=00005 name=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.295.17
output filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_undotbs1_0n8kw8pz_.dbf tag=ICIU1
recid=39 stamp=536662622
channel ORA_DISK_1: datafile copy complete, elapsed time: 00:00:25
channel ORA_DISK_1: starting incremental level 1 datafile backupset
channel ORA_DISK_1: specifying datafile(s) in backupset
including current controlfile in backupset
including current SPFILE in backupset
channel ORA_DISK_1: starting piece 1 at 12-SEP-04
channel ORA_DISK_1: finished piece 1 at 12-SEP-04
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_12/o1_mf_ncsn1_ICIU1_0n8kx51h_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
Finished backup at 12-SEP-04
```

```
Starting backup at 12-SEP-04
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting archive log backupset
channel ORA_DISK_1: specifying archive log(s) in backup set
input archive log thread=1 sequence=254 recid=142 stamp=536662633
channel ORA_DISK_1: starting piece 1 at 12-SEP-04
channel ORA_DISK_1: finished piece 1 at 12-SEP-04
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_12/o1_mf_annnn_ICIU1_0n8kxc19_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:02
channel ORA_DISK_1: deleting archive log(s)
archive log filename=+ASM_DISK_GROUP1/orcl//1_254_535733210.dbf recid=142 stamp=536662633
Finished backup at 12-SEP-04
```

So, after this run, my datafile image copies have a last modified date of “September 11, 2004, 8:00 AM” (time is approximate). At the time of this writing, it is September 12, 2004, 9:11 AM, or about 25 hours ago. So, we

can conclude that my window of recoverability is 25 hours and increasing. Since I intend to run this script again tomorrow morning, my maximum window of recoverability will be just about 48 hours.

3rd Run

On the 3rd and subsequent runs, the RECOVER command applies the previous day's level 1 incremental to the image copy (making it 24 hours old). Then the BACKUP command creates a new level 1 incremental. If you have a failure in the next 24 hours, the recover operation will apply the level 1 incremental to the image copy, then apply redo to the point in time you specify. You benefit because at most only 24 hours of redo needs to be applied to recover the database.

Here is the output from the 3rd run, executed the morning of September 13. Focus on the RECOVER command messages beginning with "starting incremental datafile backupset restore". You will see that RMAN locates the image copies in the /mnt/mickeymantle/ORCL/datafile directory, then applies the incremental created yesterday, located in the directory /mnt/mickeymantle/ORCL/backupset/2004_09_12.

The BACKUP command then creates a new level 1 incremental backup and writes it to /mnt/mickeymantle/ORCL/backupset/2004_09_13.

```

RMAN> run {
2>     recover
3>         copy of database with tag 'ICIU1';
4>     backup
5>         incremental level 1 tag 'ICIU1'
6>         for recover of copy with tag 'ICIU1'
7>         database
8>         plus archivelog delete input;
9>     }
Starting recover at 13-SEP-04
using target database controlfile instead of recovery catalog
allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: sid=255 devtype=SBT_TAPE
channel ORA_SBT_TAPE_1: NMO v4.1.0.0
allocated channel: ORA_DISK_1
channel ORA_DISK_1: sid=244 devtype=DISK
no copy of datafile 5 found to recover
channel ORA_DISK_1: starting incremental datafile backupset restore
channel ORA_DISK_1: specifying datafile copies to recover
recovering datafilecopy fno=00001
name=/mnt/mickeymantle/ORCL/datafile/o1_mf_sys tem_0n5v011x_.dbf
recovering datafilecopy fno=00002
name=/mnt/mickeymantle/ORCL/datafile/o1_mf_und otbs1_0n5v5v1m_.dbf
recovering datafilecopy fno=00003
name=/mnt/mickeymantle/ORCL/datafile/o1_mf_sys aux_0n5v3kr6_.dbf
recovering datafilecopy fno=00004
name=/mnt/mickeymantle/ORCL/datafile/o1_mf_use rs_0n5v79vp_.dbf
channel ORA_DISK_1: restored backup piece 1
piece

```

```
handle=/mnt/mickeymantle/ORCL/backupset/2004_09_12/o1_mf_nnnd1_ICIU1_0n8kt_15j_.bkp
tag=ICIU1
channel ORA_DISK_1: restore complete
Finished recover at 13-SEP-04
```

```
Starting backup at 13-SEP-04
current log archived
released channel: ORA_SBT_TAPE_1
using channel ORA_DISK_1
channel ORA_DISK_1: starting archive log backupset
channel ORA_DISK_1: specifying archive log(s) in backup set
input archive log thread=1 sequence=255 recid=143 stamp=536670990
input archive log thread=1 sequence=256 recid=144 stamp=536680905
input archive log thread=1 sequence=257 recid=145 stamp=536691670
input archive log thread=1 sequence=258 recid=146 stamp=536702450
input archive log thread=1 sequence=259 recid=147 stamp=536713238
input archive log thread=1 sequence=260 recid=148 stamp=536714281
input archive log thread=1 sequence=261 recid=149 stamp=536724029
input archive log thread=1 sequence=262 recid=150 stamp=536734873
input archive log thread=1 sequence=263 recid=151 stamp=536745658
input archive log thread=1 sequence=264 recid=152 stamp=536756448
input archive log thread=1 sequence=265 recid=153 stamp=536759345
channel ORA_DISK_1: starting piece 1 at 13-SEP-04
channel ORA_DISK_1: finished piece 1 at 13-SEP-04
piece
```

```
handle=/mnt/mickeymantle/ORCL/backupset/2004_09_13/o1_mf_annnn_ICIU1_0ncjc_n2s_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:27
channel ORA_DISK_1: deleting archive log(s)
archive log filename=+ASM_DISK_GROUP1/orcl//1_255_535733210.dbf
recid=143 stamp= 536670990
archive log filename=+ASM_DISK_GROUP1/orcl//1_256_535733210.dbf
recid=144 stamp= 536680905
archive log filename=+ASM_DISK_GROUP1/orcl//1_257_535733210.dbf
recid=145 stamp= 536691670
archive log filename=+ASM_DISK_GROUP1/orcl//1_258_535733210.dbf
recid=146 stamp= 536702450
archive log filename=+ASM_DISK_GROUP1/orcl//1_259_535733210.dbf
recid=147 stamp= 536713238
archive log filename=+ASM_DISK_GROUP1/orcl//1_260_535733210.dbf
recid=148 stamp= 536714281
archive log filename=+ASM_DISK_GROUP1/orcl//1_261_535733210.dbf
recid=149 stamp= 536724029
archive log filename=+ASM_DISK_GROUP1/orcl//1_262_535733210.dbf
```

```
recid=150 stamp= 536734873
archive log filename=+ASM_DISK_GROUP1/orcl//1_263_535733210.dbf
recid=151 stamp= 536745658
archive log filename=+ASM_DISK_GROUP1/orcl//1_264_535733210.dbf
recid=152 stamp= 536756448
archive log filename=+ASM_DISK_GROUP1/orcl//1_265_535733210.dbf
recid=153 stamp= 536759345
Finished backup at 13-SEP-04
```

```
Starting backup at 13-SEP-04
using channel ORA_DISK_1
channel ORA_DISK_1: starting incremental level 1 datafile backupset
channel ORA_DISK_1: specifying datafile(s) in backupset
input datafile fno=00001
name=+ASM_DISK_GROUP1/orcl/datafile/system.264.1
input datafile fno=00003
name=+ASM_DISK_GROUP1/orcl/datafile/sysaux.266.1
input datafile fno=00002
name=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.265.1
input datafile fno=00005
name=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.295.17
input datafile fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.268.1
channel ORA_DISK_1: starting piece 1 at 13-SEP-04
channel ORA_DISK_1: finished piece 1 at 13-SEP-04
piece
handle=/mnt/mickeymantle/ORCL/backupset/2004_09_13/o1_mf_nnnd1_ICIU1_0ncjd k12_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:56
channel ORA_DISK_1: starting incremental level 1 datafile backupset
channel ORA_DISK_1: specifying datafile(s) in backupset
including current controlfile in backupset
including current SPFILE in backupset
channel ORA_DISK_1: starting piece 1 at 13-SEP-04
channel ORA_DISK_1: finished piece 1 at 13-SEP-04
piece
handle=/mnt/mickeymantle/ORCL/backupset/2004_09_13/o1_mf_ncsn1_ICIU1_0ncjg cfo_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
Finished backup at 13-SEP-04
```

```
Starting backup at 13-SEP-04
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting archive log backupset
channel ORA_DISK_1: specifying archive log(s) in backup set
```

```

input archive log thread=1 sequence=266 recid=154 stamp=536759439
channel ORA_DISK_1: starting piece 1 at 13-SEP-04
channel ORA_DISK_1: finished piece 1 at 13-SEP-04
piece
handle=/mnt/mickeymantle/ORCL/backupset/2004_09_13/o1_mf_annnn_ICIU1_0ncjg_js9_.bkp
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:02
channel ORA_DISK_1: deleting archive log(s)
archive log filename=+ASM_DISK_GROUP1/orcl//1_266_535733210.dbf
recid=154 stamp= 536759439
Finished backup at 13-SEP-04

```

Window of Recoverability

If the script shown above is run once daily, it gives us a window of recoverability (i.e. how far back can I go?) of 24 to 48 hours. At the time of this writing, 1 PM on September 13 we have:

- ◆ Image copies of all datafiles current with September 12, approximately 9AM.
- ◆ Level 1 incremental backup that contains changes between September 12, 9AM and today at approximately 9AM.
- ◆ Online and archive logs created after 9AM today.

Therefore, using this strategy, at this time I can recover as far back as the image copies, currently about 30 hours ago.

Thus, unless I also implement additional backup strategies, I cannot recover to, for example, 3 days ago. This can be overcome – while still gaining some of the benefits of reduced recovery time – by adding a simple clause to the previous example. Note the “until time” clause added here, which provides a recoverability window of 3 days:

```

RMAN> run {
2> recover copy of database with tag 'image_copy_incr_update'
3>         until time 'sysdate - 3';
4> backup
5>     incremental level 1 tag 'level_1_for_image_copy_update'
6>     for recover of copy with tag 'image_copy_incr_update'
7>     database;
8> }

```

```

Starting recover at 09-SEP-04
[etcetera]

```

Recovery Example

Here is an example of a point-in-time recovery to 27 hours ago:

```

RMAN> run {
2> set until time "to_date('09/12/2004 10:00 AM', 'mm/dd/yyyy hh:mi am')";

```

```
3> restore database;  
4> recover database;  
5> }
```

executing command: SET until clause

Starting restore at 13-SEP-04

```
allocated channel: ORA_SBT_TAPE_1  
channel ORA_SBT_TAPE_1: sid=265 devtype=SBT_TAPE  
channel ORA_SBT_TAPE_1: NMO v4.1.0.0  
allocated channel: ORA_DISK_1  
channel ORA_DISK_1: sid=264 devtype=DISK
```

```
channel ORA_DISK_1: restoring datafile 00001  
input datafilecopy recid=43 stamp=536759333  
filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_system_0n5v011x_.dbf  
destination for restore of datafile 00001: +ASM_DISK_GROUP1/orcl/datafile/system.264.1  
channel ORA_DISK_1: copied datafilecopy of datafile 00001  
output filename=+ASM_DISK_GROUP1/orcl/datafile/system.264.1 recid=44 stamp=536765968  
channel ORA_DISK_1: restoring datafile 00002  
input datafilecopy recid=41 stamp=536759329  
filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_undotbs1_0n5v5v1m_.dbf  
destination for restore of datafile 00002: +ASM_DISK_GROUP1/orcl/datafile/undotbs1.265.1  
channel ORA_DISK_1: copied datafilecopy of datafile 00002  
output filename=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.265.1 recid=45 stamp=536766097  
channel ORA_DISK_1: restoring datafile 00003  
input datafilecopy recid=42 stamp=536759333  
filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_sysaux_0n5v3kr6_.dbf  
destination for restore of datafile 00003: +ASM_DISK_GROUP1/orcl/datafile/sysaux.266.1  
channel ORA_DISK_1: copied datafilecopy of datafile 00003  
output filename=+ASM_DISK_GROUP1/orcl/datafile/sysaux.266.1 recid=46 stamp=536766274  
channel ORA_DISK_1: restoring datafile 00004  
input datafilecopy recid=40 stamp=536759313  
filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_users_0n5v79vp_.dbf  
destination for restore of datafile 00004: +ASM_DISK_GROUP1/orcl/datafile/users.268.1  
channel ORA_DISK_1: copied datafilecopy of datafile 00004  
output filename=+ASM_DISK_GROUP1/orcl/datafile/users.268.1 recid=47 stamp=536766281  
channel ORA_DISK_1: restoring datafile 00005  
input datafilecopy recid=39 stamp=536662622  
filename=/mnt/mickeymantle/ORCL/datafile/o1_mf_undotbs1_0n8kw8pz_.dbf  
destination for restore of datafile 00005: +ASM_DISK_GROUP1/orcl/datafile/undotbs1.295.17  
channel ORA_DISK_1: copied datafilecopy of datafile 00005  
output filename=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.295.17 recid=48 stamp=536766351  
Finished restore at 13-SEP-04
```

Starting recover at 13-SEP-04

```
using channel ORA_SBT_TAPE_1
using channel ORA_DISK_1

starting media recovery

channel ORA_DISK_1: starting archive log restore to default destination
channel ORA_DISK_1: restoring archive log
archive log thread=1 sequence=254
channel ORA_DISK_1: restored backup piece 1
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_12/o1_mf_annnn_ICIU1_0n8kxc19_.bkp
tag=ICIU1
channel ORA_DISK_1: restore complete
archive log filename=+ASM_DISK_GROUP1/orcl//1_254_535733210.dbf thread=1 sequence=254
channel ORA_DISK_1: starting archive log restore to default destination
channel ORA_DISK_1: restoring archive log
archive log thread=1 sequence=255
channel ORA_DISK_1: restored backup piece 1
piece handle=/mnt/mickeymantle/ORCL/backupset/2004_09_13/o1_mf_annnn_ICIU1_0ncjcn2s_.bkp
tag=ICIU1
channel ORA_DISK_1: restore complete
archive log filename=+ASM_DISK_GROUP1/orcl//1_255_535733210.dbf thread=1 sequence=255
media recovery complete
Finished recover at 13-SEP-04
```

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

```
database opened
```

```
RMAN>
```

Conclusion

Recovering with image copies is faster than recovering with normal backups (RMAN has always favored image copies over regular backupsets during recovery operations). For shops where lots of changes create lots of redo logs and recovery time is critical, the Incrementally Updated Image Copies feature – applying level 1 incrementals into image copies – should be considered as a replacement to existing incremental backup strategies.

Questions

Email your questions to dave@skillbuilders.com.

Q. Will RMAN apply more than one level one incremental to the image copy – even if it was not specifically created for the image copy?

A. Yes. See in the test below that there are two separate incremental backups of tablespace “users” are applied to the image copy:

```
RMAN> backup incremental level 1 tablespace users tag 'test_incr1';
```

```
Starting backup at 09-SEP-04
using channel ORA_DISK_1
channel ORA_DISK_1: starting incremental level 1 datafile backupset
channel ORA_DISK_1: specifying datafile(s) in backupset
input datafile fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.268.1
channel ORA_DISK_1: starting piece 1 at 09-SEP-04
channel ORA_DISK_1: finished piece 1 at 09-SEP-04
piece handle=+ASM_DISK_GROUP1/orcl/backupset/2004_09_09/nnndn1_test_incr1_0.349.1
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:03
Finished backup at 09-SEP-04
```

```
RMAN> backup incremental level 1 tablespace users tag 'test_incr1';
```

```
Starting backup at 09-SEP-04
using channel ORA_DISK_1
channel ORA_DISK_1: starting incremental level 1 datafile backupset
channel ORA_DISK_1: specifying datafile(s) in backupset
input datafile fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.268.1
channel ORA_DISK_1: starting piece 1 at 09-SEP-04
channel ORA_DISK_1: finished piece 1 at 09-SEP-04
piece handle=+ASM_DISK_GROUP1/orcl/backupset/2004_09_09/nnndn1_test_incr1_0.350.1
comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:03
Finished backup at 09-SEP-04
```

```
RMAN> recover copy of database with tag 'image_copy_incr_update';
```

```
Starting recover at 09-SEP-04
allocated channel: ORA_SBT_TAPE_1
channel ORA_SBT_TAPE_1: sid=253 devtype=SBT_TAPE
channel ORA_SBT_TAPE_1: NMO v4.1.0.0
using channel ORA_DISK_1
channel ORA_DISK_1: starting incremental datafile backupset restore
channel ORA_DISK_1: specifying datafile copies to recover
recovering datafilecopy fno=00001 name=+ASM_DISK_GROUP1/orcl/datafile/system.296.7
recovering datafilecopy fno=00002 name=+ASM_DISK_GROUP1/orcl/datafile/undotbs1.301.5
recovering datafilecopy fno=00003 name=+ASM_DISK_GROUP1/orcl/datafile/sysaux.297.5
recovering datafilecopy fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.304.5
channel ORA_DISK_1: restored backup piece 1
piece
handle=+ASM_DISK_GROUP1/orcl/backupset/2004_09_09/nnndn1_level_1_for_image_copy_update_0.
347.1 tag=LEVEL_1_FOR_IMA
GE_COPY_UPDATE
channel ORA_DISK_1: restore complete
```

```
channel ORA_DISK_1: starting incremental datafile backupset restore
channel ORA_DISK_1: specifying datafile copies to recover
recovering datafilecopy fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.304.5
channel ORA_DISK_1: restored backup piece 1
piece handle=+ASM_DISK_GROUP1/orcl/backupset/2004_09_09/nnndn1_test_incr1_0.349.1
tag=TEST_INCR1
channel ORA_DISK_1: restore complete
channel ORA_DISK_1: starting incremental datafile backupset restore
channel ORA_DISK_1: specifying datafile copies to recover
recovering datafilecopy fno=00004 name=+ASM_DISK_GROUP1/orcl/datafile/users.304.5
channel ORA_DISK_1: restored backup piece 1
piece handle=+ASM_DISK_GROUP1/orcl/backupset/2004_09_09/nnndn1_test_incr1_0.350.1
tag=TEST_INCR1
channel ORA_DISK_1: restore complete
Finished recover at 09-SEP-04
```