How to Best Configure, Size, and Monitor the Oracle Database Fast Recovery Area

Cris Pedregal, Oracle
**Fast Recovery Area – Key MAA Element**

RMAN + Secure Backup + Flashback + Data Guard

Integrated backup & recovery, continuous data protection, disaster recovery
Fast Recovery Area (FRA)
Stores and manages all recovery-related files

- Database Area
- Daily Apply Validated Incremental
- Fast Recovery Area
- Weekly Archive To Disk / Tape
**FRA in Enterprise Manager**

Log Archive Filename Format: `%d_%s_%s.dbf`

<table>
<thead>
<tr>
<th>Number</th>
<th>Archived Redo Log Destination</th>
<th>Status</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USE_DB_RECOVERY_FILE_DEST</td>
<td>VALID</td>
<td>Local</td>
</tr>
</tbody>
</table>

**TIP** It is recommended that archived redo log files be written to multiple locations spread across the different disks.

**Enable Minimal Supplemental Logging**

Minimal supplemental logging logs the minimal amount of information needed for LogMiner (an application built on LogMiner technology) to identify, group, and merge redo operations associated with DML changes.

**Fast Recovery**

The database is using a fast recovery area. The chart shows space used by each file type that is not reclaimable by Oracle. Performing backups to tertiary storage is one way to make space reclaimable. Usable Fast Recovery Area includes free and reclaimable space.

- **Fast Recovery Area Location**: `/omdata/prod/fra`
- **Fast Recovery Area Size**: 100 GB
- **Non-reclaimable Fast Recovery Area (GB)**: 0.84
- **Reclaimable Fast Recovery Area (GB)**: 23.09
- **Free Fast Recovery Area (GB)**: 68.07

**Enable Flashback Database**

Flashback database can be used for fast database point-in-time recovery, as it returns the database to a prior point-in-time without restoring files. Flashback is the preferred point-in-time recovery method in the recovery wizard when appropriate. The fast recovery area must be set to enable flashback database.

- **Flashback Retention Time**: 24 Hours
- **Current size of the flashback logs (MB)**: 30.391
  - Lowest SCN in the flashback data: 3945600
  - **Flashback Time**: Sep 26, 2011 12:53:23 PM

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Agenda

• Oracle Fast Recovery Area (FRA) overview

• How to best configure, size, and monitor the FRA
  – Files to keep in FRA & relationship to Backup policy and Flashback
  – Configuring FRA Size and Location & EM view of the FRA

• Enkitec’s Real-World Experiences
Files Necessary for Fast Recovery

Transient Files
- Archived Redo logs
- Backup files and autobackups
- Flashback logs (if FB enabled)
- Oracle knows when to delete or trim
- Age-out or backed-up to tertiary

Permanent Files
- Multiplexed Control File
- Multiplexed Online Redo
- Guaranteed Restore Points
- Complete the set for fast recovery
- Could fill up FRA so DBA must monitor
Best Practice: Generous FRA on ASM

- All recovery-related files in Fast Recovery Area
- FRA on ASM with enough space and spindles
Configuring the Fast Recovery Area

- **Size** – backups, archived logs, redo, flashback…

- **Location** – fast, available disk
Two Configuration Parameters to create FRA
Set Space Quota and Storage location

• Disk Quota: `DB_RECOVERY_FILE_DEST_SIZE`
  – Per Database; provision for all permanent and transient files

• Location: `DB_RECOVERY_FILE_DEST`
  – File system directory or ASM group

Set via DB Configuration Assistant, or DB initialization parameter file, or SQL (ALTER SYSTEM SET)
Fast Recovery Area in Enterprise Manager
Location, Size, Usage Breakdown

Viewlet
Agenda

- Oracle Fast Recovery Area (FRA) overview

- How to best configure, size, and monitor the FRA
  - Given Backup & Flashback policy, count files FRA needs to keep
  - How to get number and size of files. Multiply and add to FRA size

- Enkitec’s Real-World Experiences
FRA Size: Summing Files in FRA by Example

2 Comprehensive Scenarios Show How to Sum Up All Files

• Both scenarios: 7-day recovery window
  RMAN> configure retention policy to recovery window of 7 days;

• Scenario #1: all recovery files for window are in FRA

• Scenario #2: adds FRA backup to external storage to 1
  • Flashback enabled in both scenarios

  – We do not take into account disk mirroring –a good practice, omitted for simplicity
7-Day Window, No Tape - Scripts
Daily: Roll forward image copy and take incremental backup

# daily disk (keeps 7-day-old image copy)
recover copy of database with tag DB_BACKUP
until time 'sysdate-8';
backup incremental level 1 for recover of
copy with tag DB_BACKUP database;
7-Day Window, No Tape – Sum up needed files
FRA disk space needed – add these file sizes:

= Control File size
+ Online Redo Log size
+ size of Archived Logs (for 8 days)
+ Database size (minus temp files)
+ size of Incremental Backups (for 8 days)
+ Flashback Logs size (initially Redo rate X FB retention time)

• For load spikes: 1.5 to 2 X space for Archive and Flashback logs
7-Day Window, with Tape - Scripts
Daily incremental and back up FRA to tape every 2 days

# Daily disk (7 day window using tape)
recover copy of database with tag DB_BACKUP;
backup incremental level 1 for recover of copy with tag DB_BACKUP database;
# Tape backup executed once every 2 days
backup recovery area;
delete obsolete device type sbt;
7-Day Window, with Tape – File Count

FRA disk space needed – add these sizes

= Control File size
+ Online Redo Log size
+ size of Archived Logs (for 3 days – tape every 2)
+ Database size (minus temp files)
+ size of Incremental Backups (for 3 days – tape)
+ Flashback Logs size (initially Redo rate X FB retention time)

• For load spikes: 1.5 to 2 X space for Archive and Flashback logs
Counting Files in FRA – Notes

• Easy to account for mirroring, or multiple copies of logs
  – multiply space requirement as needed (full FRA, or log type)

• As of 11g Release 2, can back up FRA to secondary disk
Counting Files in FRA – Recap
Function of Recovery Window, Flashback, Tape Use

• Oracle *implicitly* deletes obsolete (or trims) files in FRA
  – Tertiary storage not part of FRA, hence explicit sbt delete command

• *Tradeoff*: use less FRA space for slower (tape) recovery
  – Both scenarios provide the same 7-day recovery window

… What about Flashback?
Configuring Flashback

Flashback Logs Managed by Oracle in FRA

• If Flashback is enabled, must specify Flashback window
  – `DB_FLASHBACK_RETENTION_TARGET`

• To check that Flashback window is met by logs in FRA
  – `SELECT oldest_flashback_scn, oldest_flashback_time
    FROM v$flashback_database_log;`
FRA and Flashback Queries

Location, quota, in use/reclaimable space, number of files

```
SELECT * FROM v$recovery_file_dest;
```

For each file type, percent of FRA space it uses and is reclaimable and number of files of that type

```
SELECT * FROM v$recovery_area_usage;
```

Estimated space used by Flashback logs

```
SELECT estimated_flashback_size FROM v$flashback_database_log;
```
FRA Size: Queries to Determine File Sizes

- Backup and Flashback policies define which/how many files are kept for how long in FRA –
  - We already learned by example how to sum up those files

- To obtain FRA size, need the size of each file
  - Oracle provides views, used by EM or directly via SQL -- next
FRA Size – How to Determine File Sizes
Using SQL Queries
Sizes: Image Copy, Online Redo, Control File

• Size of Database Image Copy File
  
  SELECT SUM(bytes) fsize FROM V$DATAFILE;

• Size of Online Redo Log
  
  SELECT SUM (bytes*blocksize) fsize FROM V$LOG;

• Size of Control File
  
  SELECT (block_size * file_size_blks) fsize
  FROM V$CONTROLFILE WHERE rownum = 1;
Sizes (2): Incremental Backups

- Size of Incremental Backups Generated so far

```sql
SELECT end_time, output_bytes
FROM V$RMAN_BACKUP_JOB_DETAILS
WHERE input_type = 'DB INCR'
ORDER BY end_time DESC;
```
Sizes (3): Archived Logs generated per day

SELECT TO_CHAR(first_time,'DD-MON-YYYY') "Date",
SUM(bytes)
FROM (SELECT UNIQUE
blocks * block_size bytes,
thread#,
sequence#,
resetlogs_change#,
first_time
FROM V$ARCHIVED_LOG$
)
GROUP BY TO_CHAR(first_time, 'DD-MON-YYYY')
ORDER BY 1 DESC;
Sizes (4): Flashback Logs

- If Flashback is enabled
  
  ```sql
  SELECT estimated_flashback_size,
          FROM V$FLASHBACK_DATABASE_LOG;
  ```

  – See also the value of the current flashback logs via:
    
    ```sql
    SELECT flashback_size FROM V$FLASHBACK_DATABASE_LOG;
    ```
Agenda

• Oracle Fast Recovery Area (FRA) overview

• How to best configure, size, and monitor the FRA
  – Additional considerations - multiple databases and Exadata
  – The DBA needs to remain involved

• Enkitec’s Real-World Experiences
Configuring the FRA – Multiple Databases

To share one FRA across multiple Databases

• Set same value for DB_RECOVERY_FILE_DEST on all
• Use different DB_UNIQUE_NAMEs (if undefined, different DB_NAMEs)
• Separate directories will be created for each Database
Configuring the FRA – Exadata Considerations

- FRA must be on local Storage – ASM diskgroup RECO
- With Disk Backups on External Storage, RECO set to 20% of total disk space
- No External Backups, RECO is 60% of disk space
- File Locations
  - Archived and Flashback Logs and all Backup go in FRA
  - Control Files and Redo Logs in High Redundancy Disk group

More: Session 12962 Exadata Backup & Recovery
“Bad” Practices for Fast Recovery Area

A few “DO NOTs”

1. DO NOT use FORMAT to back up files to FRA

2. DO NOT specify LOG_ARCHIVE_DEST_n to FRA location to archive files to FRA. Instead use 'USE_DB_RECOVERY_FILE_DEST', e.g.,
   - LOG_ARCHIVE_DEST_1='location=USE_DB_RECOVERY_FILE_DEST'

3. DO NOT delete files from FRA using OS commands or asmcmd utility
   - Instead use RMAN’s DELETE command

4. DO NOT specify DB_RECOVERY_FILE_DEST_SIZE to more than the available disk space

5. DO NOT keep Guaranteed Restore Points around forever. They take up disk space permanently
The DBA Must Remain Involved

FRA automates a lot, but the DBA is still in the loop:

• Optimizing resource usage (scarce by definition)
• Tracking changes – in activity volume, in RTO/RPO -- and adjusting / prioritizing

… Oracle takes care of routine space management

ORA-19809: limit exceeded for recovery files
How to Best Configure, Size, and Monitor the Oracle Database Fast Recovery Area

Presented by: Andy Colvin
Principal Consultant, Enkitec
October 6, 2011
About Me/Enkitec

• Who am I?
  • Principal Consultant at Enkitec
  • Worked with Oracle dating back to version 7

• What is Enkitec?
  • Oracle-centered Platinum Partner based in Irving, TX
  • Database consultants averaging over 15 years Oracle experience
  • Making a name for ourselves in the Exadata world
Why I Use the FRA

- Ease of use
- Allows for DBA-level space management
- Provides for easier standardization of environments
  - Uniform place for all recovery-related files

SQL> select NAME, (SPACE_USED/SPACE_LIMIT)*100 "% USED" from V$RECOVERY_FILE_DEST;

<table>
<thead>
<tr>
<th>NAME</th>
<th>% USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>/u03/fast_recovery_area</td>
<td>85.87</td>
</tr>
</tbody>
</table>
Two Real World Customers

Customer #1 - Document Processing

- $350M Revenue, 8,500 employees
- Services 50% of Fortune 100

Customer #2 - Energy Utility

- $15B Revenue, 5 million customers
Customer #1 - Document Processing

- 15TB database, production environment
- Repository for document management
- 270 GB of redo generated daily
- Backups going directly to tape
#1 - Accelerated Database Growth

7x Growth in 3 Years

Database Size - TB

#1 - Document Processing - Solution

- FRA originally sized at 2TB (based on 7 day archive log retention)
- Monitored database growth with OEM
- Monitored redo generation through Data Guard console in OEM
- Increased `db_file_recovery_dest_size` to match the growth of the database monthly
- FRA now sized at 9TB
Data Guard Considerations

- Standby environment created identical to primary
  - Exadata → Exadata
  - Same size diskgroups for +DATA and +RECO
- All logs sent to FRA
- Always remember that DR site has to be able to run as primary!
  - This includes FRA size - backups, flashback, archive logs, etc
#1 - Backup Commands

#RMAN archivelog backup command

backup archivelog all not backed up

- Avoid “delete obsolete” through RMAN - Allow the FRA to manage files itself
- Example of FRA automatic file management:
  deleted Oracle managed file <file_name>
#1 - FRA file management

RMAN> backup archivelog all not backed up;

skipping archived log file <archive_log>; already backed on <date>

skipping archived log file <archive_log>; already backed on <date>

skipping archived log file <archive_log>; already backed on <date>

... 

input archived log thread=1 sequence=7 RECID=26 STAMP=762905532

input archived log thread=1 sequence=8 RECID=27 STAMP=762905541
Customer #2 - Energy Utility

- Development database
- Customer billing transaction system - will service 5 million customers
- 600GB database
- Backups going to FRA and tape
- Weekly data refresh
- Flashback database enabled
#2 - Energy Utility - Solution

- FRA sized at 150GB
- Sizing based on:
  - Flashback logs
  - Archive log generation
  - Database backups
- Frequent database flashbacks
Flashback Methodology

- Flashback retention set to 1 week
- Created a guaranteed restore point before each refresh, data refreshed weekly
- Monitored the usage of the FRA through OEM reports, alerting based on space available
- After process was repeated a few times, optimal FRA size was found, based on recovery file generation
## #2 - Energy Utility - Solution

### Monitoring FRA Usage

SQL> SELECT * FROM V$FLASH_RECOVERY_AREA_USAGE WHERE PERCENT_SPACE_USED > 0 ;

<table>
<thead>
<tr>
<th>FILE_TYPE</th>
<th>% USED</th>
<th>% RECLAIM</th>
<th># FILES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTROL FILE</td>
<td>0.24</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>REDO LOG</td>
<td>3.72</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>ARCHIVED LOG</td>
<td>31.11</td>
<td>26.82</td>
<td>31</td>
</tr>
<tr>
<td>BACKUP PIECE</td>
<td>33.17</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>FLASHBACK LOG</td>
<td>17.6</td>
<td>0</td>
<td>42</td>
</tr>
</tbody>
</table>
Two Real World Customers

Customer #1 - Document Processing

Customer #2 - Energy Utility

What we learned from each

- Configuring and sizing FRA was quick and easy
- Monitoring usage of the FRA is imperative, especially with rapid database growth
- Be prepared to tweak the settings during the initial stages
FRA On Exadata and ODA

- Planning the size of the FRA is even more important with Oracle’s engineered systems.

- Disk sizing is more difficult to perform on these systems after they are in place because the diskgroups share the same physical disks.

- If you have the space, leave plenty for RECO, so that you can utilize image copies and longer flashback/backupset retention period.
Questions?

Andy Colvin, Enkitec

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http://blog.oracle-ninja.com
andy.colvin@enkitec.com
Best Practice: Provision, Monitor, Repeat

• Provision per Oracle’s recommendations

• Monitor your database’s steady state
  – Also account for peak loads
  – Understand how FRA deletes files and handles scarce or exhausted resources, and how a DBA can intervene

• Repeat
Summary: FRA for Simple Fast Recovery

- Create FRA on ASM and let it manage all recovery files
  - Make FRA part of your High Availability strategy

- Provision, Monitor, Repeat
  - Understand how FRA works and when DBA action is necessary

*Use the FRA for simple & fast recovery*
Q&A
Resources

• OTN HA Portal:
  http://www.oracle.com/goto/availability

• Maximum Availability Architecture (MAA):
  http://www.oracle.com/goto/maa

• MAA Blogs:
  http://blogs.oracle.com/maa

• Exadata on OTN:

• Oracle HA Customer Success Stories on OTN:
### Monday, 3 Oct – Moscone South *

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>11:00a</td>
<td>Auto Detect, Prevent and Repair Data Corruptions</td>
<td>Rm 102</td>
</tr>
<tr>
<td>12:30p</td>
<td>Future of Oracle Exadata</td>
<td>Rm 104</td>
</tr>
<tr>
<td>12:30p</td>
<td>RMAN: Not Just for Backups Anymore</td>
<td>Rm 304</td>
</tr>
<tr>
<td>2:00p</td>
<td>Extreme Data Management</td>
<td>Moscone North Hall D</td>
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<tr>
<td>5:00p</td>
<td>Oracle High-Availability System Overview</td>
<td>Rm 104</td>
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<tr>
<td>5:00p</td>
<td>GoldenGate Product Update and Strategy</td>
<td>Intercontinental-Sutter</td>
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### Tuesday, 4 Oct – Moscone South *

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<tr>
<td>10:15a</td>
<td>Oracle Secure Backup - Best practices</td>
<td>Rm 304</td>
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<td>11:45a</td>
<td>Oracle Exadata Technical Deep Dive</td>
<td>Rm 104</td>
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<td>3:30p</td>
<td>RMAN &amp; Data Guard: Seven Cool Tips from Oracle</td>
<td>Rm 304</td>
</tr>
<tr>
<td>3:30p</td>
<td>Consolidation on Oracle Exadata</td>
<td>Rm 103</td>
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### Wednesday, 5 Oct – Moscone South *

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<th>Time</th>
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<tr>
<td>10:15a</td>
<td>Oracle Active Data Guard - Lessons Learned</td>
<td>Rm 102</td>
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<td>1:15p</td>
<td>Data Guard for Planned Maintenance</td>
<td>Rm 102</td>
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<tr>
<td>1:15p</td>
<td>Understanding Oracle RAC Internals</td>
<td>Rm 103</td>
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<td>1:15p</td>
<td>Clone Oracle with CloneDB and Direct NFS</td>
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### Thursday, 6 Oct – Moscone South *

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<thead>
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<th>Time</th>
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<tr>
<td>9:00a</td>
<td>Exadata Backup and Recovery</td>
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<td>10:30a</td>
<td>Deduplication and Compression for Backups</td>
<td>Rm 304</td>
</tr>
<tr>
<td>12:00p</td>
<td>Data Guard Switchover / Failover</td>
<td>Rm 103</td>
</tr>
<tr>
<td>3:00p</td>
<td>Configure, Size, Monitor Fast Recovery Area</td>
<td>Rm 304</td>
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<tr>
<td>3:00p</td>
<td>PeopleSoft with Active Data Guard</td>
<td>Moscone West 2022</td>
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</tbody>
</table>

### Demos Moscone South DEMOGrounds

- **Mon & Tue 9:45a - 5:30p; Wed 9:00a - 4:00p**
- Maximum Availability Architecture (MAA)
- Exadata
- Active Data Guard
- Oracle Secure Backup
- Recovery Manager & Flashback
- GoldenGate
- Real Application Clusters
- ASM

### Hands-on Labs Marriott Marquis, Salon 14 / 15

- **Monday, Oct 3, 5:00 pm - 6:00 pm** Oracle Active Data Guard
- **Tuesday, Oct 4, 10:15 am - 11:15 am** Oracle Active Data Guard

*All session rooms at Moscone South unless otherwise noted
Hardware and Software
Engineered to Work Together