Introduction to Automatic Storage Management

An overview of ASM, the Oracle 10g file and volume management system.

SKILLBUILDERS

Topics

- Introduction to ASM
- Benefits
- Architecture
- Installation tips
- Starting ASM
- ASM Disks, Diskgroups and Failgroups
- Managing ASM with asmcmd
- ASM from the Database Instance
- ASM and SAN Tips
- Miscellaneous Release 2 enhancements

What is ASM?...

- ASM = *Automatic* Storage Management
  - It does lots of storage-related things for you
- Built-in “database file system”
- Storage for database-related things only
  - Tables, indexes, tempfiles, backup sets, control files, parameter files, redo logs, archive logs, dump sets

...What is ASM?

- Mirrors and stripes data (RAID 1+0)
  - Mirrored stripes
  - Good R/W performance
  - Good availability
    - Loss of disk causes background rebalance operation to remirror stripes on available space
- Works with
  - Single server or RAC environments
  - NAS / SAN or DAS devices
  - Can turn off ASM mirror – use NAS
- Bundled with database – in kernel

Benefits of ASM...

- Simpler administration
  - Manage small number of disk groups
    - Not hundreds / thousands of datafiles
  - ASM balances IO load
    - Dynamic parallel load balancing
      - Helps prevent hot spots
      - IO spread evenly across available disks
    - Control for intrusiveness of rebalance operations
      - See ASM_POWER_LIMIT

...Benefits of ASM...

- Performance
  - Raw device performance
    - Without raw device management
  - Oracle TPC tests using ASM
- Redundancy
  - 2 or 3 way mirroring
    - Or use hardware mirroring

...Benefits of ASM

- High Availability
  - Add / remove drives online
  - Move files online
  - Automatic, controllable, online rebalancing
- Bundled with database
  - SE1, SE and EE

Automated S.A.M.E.

- S.A.M.E.
  - "Stripe and Mirror Everything"
- Striping to balance I/O load
  - Good performance
  - Uses optimal stripe size for Oracle datafiles
  - Typically 1MB
  - 128k stripe for control files
- Mirroring for redundancy, availability

Other Points...

- ASM built on top of raw devices
  - Don't use on top of other file systems
    - Except maybe for testing
    - Undoc'd parameter _asm_allow_only_raw_disks
- Raw performance w/o raw management
- Can coexist with other file management techniques
  - Can migrate incrementally
  - 10g DBMS_FILE_TRANSER can be used
  - RMAN commands

...Other Points

- ASM files are *not* visible to OS
  - Use RMAN to backup
- 10g "BIGFILES" are designed for ASM
  - Or another striping solution
- OEM provides nice management interface
- ASM complements Oracle9i Managed Files

```
LINUX> show parameter db_create
NAME                                 TYPE        VALUE
------------------------------------ ----------- -------
db_create_file_dest                  string      +GROUP1
```

OMF points to disk group

The ASM Instance...

- ***One ASM instance required on server***
  - ***One ASM instance per node in RAC***
- ***A separate instance from DB instance***
  - ***See parameter INSTANCE_TYPE=+ASM***
  - ***ASM instance services one or more database instances on a node***
- ***Requires approximately 100MB memory***
  - ***Memory requirements said to be static***

...The ASM Instance...

- Manages diskgroup metadata
  - Diskgroup is group of physical disks / LUNs
- Each physical Oracle server has one ASM instance
  - Used by all database instances on server
  - Each node in RAC cluster has 1 ASM instance

...The ASM Instance

- ***Starts background processes to manage ASM disk metadata***
  - ***RBAL***
  - ***ARBn***
  - ***GMON***
- ***ASM instance has no database***
  - ***No datafiles, control file, log files***
  - ***ASM disk metadata triple-mirrored on ASM disks***
  - Metadata backed up with database backups
  - ***No need for separate ASM backups***

ASM Install Tips

- DBCA can
  - Create ASM instance only
    - Even if server already contains DB
  - Create ASM and database instance
  - Create database using existing ASM instance
- Consider putting in ASM separate home
  - Patch separately
- Give ASM raw disks to discover
  - See the ASM_DISKSTRING parameter
- CSS required

ASM Parameters

```
instance_type='asm'
+asm.asm_diskgroups='DATAFILE_GROUP','FLASHBACK_GROUP'
asm_diskstring='c:\asmdisks\_file*'
asm_power_limit=1  # 1 (low),  11 (high)
processes=55      #set to handle 2 database instances
large_pool_size=12M
shared_pool_size=40m
db_cache_size=24m
remote_login_passwordfile='exclusive'
user_dump_dest='C:\oracle\product\10.2.0\admin\+ASM\udump'
background_dump_dest='C:\oracle\product\10.2.0\admin\+ASM\bdump'
core_dump_dest='C:\oracle\product\10.2.0\admin\+ASM\cdump'
compatible='10.2.0.1.0'
```

Starting ASM

- Start ASM first
  - Mounts all diskgroups in ASM_DISKGROUPS parameter
- Shutdown ASM last

```
[oracle@springsteen oracle]$ ORACLE_SID=+ASM
[oracle@springsteen oracle]$ sqlplus / as sysdba
. . .
SQL> startup
ASM instance started

Total System Global Area  100663296 bytes
Fixed Size                   777616 bytes
Variable Size              99885680 bytes
Database Buffers                  0 bytes
Redo Buffers                      0 bytes
ASM diskgroups mounted
SQL>
```

Default ASM instance name

Must (always) connect as SYSDBA

Mounts disks; no database to open!

ASM Disks

- ASM disks must be discovered
  - Give raw devices to ASM
- Parameter ASM_DISKSTRING to discover disks
  - At ASM startup
  - Can limit to specific disks

```
SQL> select name, path, total_mb, free_mb,
  2         reads, writes
  3  from v$asm_disk;
NAME          PATH              TOTAL_MB    FREE_MB
------------ -------------- ----------- ----------
GROUP1_0003  /dev/raw/raw4         34710
GROUP1_0002  /dev/raw/raw3         34710      29852
GROUP1_0001  /dev/raw/raw2         34710      29213
GROUP1_0000  /dev/raw/raw1         32718      28416
```

ASM instance shows all available disks

Database shows disks in use by that database

ASM Diskgroups

- Like a volume or storage group
- Contain ASM files
- Used by one or more database instances
- ASM_DISKGROUP parameter identifies diskgroups mounted
- Striping for balanced IO load across disks
  - File's extents "distributed equally across all … disks in the diskgroup"*

See the CREATE DISKGROUP example later in this lesson

ASM Failgroups

- Failgroups provide ASM (internal) mirroring
- Mirroring options
  - External
    - Use EMC or other storage product
  - Normal
    - 2-way
  - High
    - 3-way

Creating Diskgroup

```
+ASM> create diskgroup group1 normal redundancy
  2  failgroup fgroup1 disk '/dev/raw/raw1', '/dev/raw/raw2'
  3  failgroup fgroup2 disk '/dev/raw/raw3', '/dev/raw/raw4';

Diskgroup created.

SQL> select * from v$asm_diskgroup;

GROUP_NUMBER NAME            SECTOR_SIZE BLOCK_SIZE
------------ ------------ ----------- ----------
           1 GROUP1               512       4096

ALLOCATION_UNIT_SIZE STATE     TYPE     TOTAL_MB      FREE_MB
-------------------- -------   ------   --------      -------
             1048576 MOUNTED   NORMAL     136848       136744
```

```
+ASM> select g.name as group_name, d.name as disk_name, d.path, d.failgro
  2  from v$asm_diskgroup g, v$asm_disk d
  3  where g.group_number = d.group_number

GROUP_NAME DISK_NAME        PATH              FAILGROUP
---------  ---------------- ----------------- -------
GROUP1     GROUP1_0003      /dev/raw/raw4     FGROUP2
GROUP1     GROUP1_0002      /dev/raw/raw3     FGROUP2
GROUP1     GROUP1_0001      /dev/raw/raw2     FGROUP1
GROUP1     GROUP1_0000      /dev/raw/raw1     FGROUP1
```

Altering Diskgroup

- Easily add or remove disks while database open
- Automatic rebalancing starts

```
+ASM> alter diskgroup group1 drop disk GROUP1_0002;

Diskgroup altered.

+ASM> select * from v$asm_operation
  2  /

GROUP_NUMBER OPERA STAT      POWER     ACTUAL       SOFAR   EST_WORK   EST_RATE
------------ ----- ---- ---------- ---------- ---------- ---------- ----------
           1 REBAL RUN           1          1        181       1275        338

EST_MINUTES
-----------
          3
```

Referencing Disk Group...

- Creating datafiles follow 9i OMF conventions
  - Location
  - Size
- New file name convention

```
LINUX> create tablespace class datafile size 5m;

Tablespace created.

LINUX> select file_name, bytes from dba_data_files
  2    where tablespace_name = 'CLASS';

FILE_NAME                                          BYTES
-------------------------------------- ----------
+GROUP1/linux3/datafile/class.1083.1      5242880
```

DROP removes file from ASM diskgroup

```
LINUX> drop tablespace class;

Tablespace dropped.
```

...Referencing Disk Group

- Easy to override OMF diskgroup

Just specify diskgroup name; ASM figures out the rest

```
LINUX> create tablespace class datafile '+group1' size 1m;

Tablespace created.

LINUX> select file_name, bytes from dba_data_files
  2  where tablespace_name = 'CLASS';

FILE_NAME                                          BYTES
-------------------------------------- ----------
+GROUP1/linux3/datafile/class.1083.3     1048576
```

```
LINUX> alter tablespace class add datafile '+group1' size 1m;

Tablespace altered.
```

Use diskgroup name in ALTER

ASMCMD

- Command line interface
- Alternative to managing with SQL or OEM
- Supports scripting

Commands similar to Unix

```
[oracle@springsteen oracle]$ ORACLE_SID=+ASM
[oracle@springsteen oracle]$ asmcmd
ASMCMD> ls -l group1/linux3/datafile
Type      Redund  Striped  Time             Sys  Name
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    DAVES_TS.1162.9
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    DEFAULT_USERS.13
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    EXAMPLE.269.1
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    SKILL.1221.7
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    SYSAUX.257.1
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    SYSTEM.256.1
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    UNDOTBS1.258.1
DATAFILE  MIRROR  COARSE   JAN 05 10:00:00  Y    USERS.957.7
ASMCMD> du
Used_MB      Mirror_used_MB
   6790             13591
```

R2 Enhancements...

- OEM provides ASM migration utility
- DBMS_FILE_TRANSFER
  - Migrate to or from ASM / OS file system
- Backward / forward compatibility
  - 10.2 ASM instance supports 10.1 database
  - 10.1 ASM instance supports 10.2 database
- FTP tool to copy files in / out
- XML DB virtual folder support

...R2 Enhancements...

- New views
  - VASM_DISK_STAT, VASM_DISKGROUP_STAT
  - More efficient than V$DISK, V$ASM_DISKGROUPUsable free space
  - Space that's safe to use considering mirroring
- RAC and single-instance DB's can share an ASM instance
- STARTUP displays ASM Cache size

...R2 Enhancements

- SHUTDOWN returns error if database connected
  - ORA-15097
- Wait for rebalance op to complete
  - Request WAIT on ALTER DISKGROUP
  - Can help in scripts
- ASM_POWER_LIMIT=0
  - Disables automatic rebalance ops
  - Suspends in-progress ops

ASM and SAN Best Practices

- Use ASM external redundancy
  - Let NAS create mirrors
- Use like disks in one disk group
- Give more than 1 LUN to a disk group
  - Let ASM do the striping
  - No performance hit for double striping (stripe-on-stripe)

ASM and SAN Best Practices

- Use a multi-pathing solution to prevent SPOF on SAN
  - e.g. HP Secure Path, EMC Powerpath
  - Manage device (LUN) with ASM or LVM, not both
- Configure async I/O
- Many white papers on ASM home page
  - oracle.com/technology/products/database/asm

Summary...

- ASM is a built-in file system and volume manager
  - Provides automated S.A.M.E.
  - Easier disk management
  - Use instead of other file systems
- ASM instance manages diskgroup metadata
  - One per physical server
- Install ASM with DBCA
  - Put in separate home
- At startup:
  - ASM_DISKSTRING controls disk discovery
  - ASM_DISKGROUP names diskgroups to be mounted

...Summary

- Diskgroup is the main object
  - Define disks in the group
  - Define failgroups for redundancy
- Manage ASM with SQL or asmcmd
  - asmcmd provides Unix-like commands
- Backup datafiles with RMAN
  - Datafiles not visible to the OS
- Can mix ASM files with OS or raw
- R2 provides DBMS_FILE_TRANSFER for migration
- Works with NAS/SAN, DAS
- Works for single-instance or RAC databases
- Nice feature!

Helpful Resources

- Class from SkillBuilders, free tutorials
  - See www.skillbuilders.com
- ASM Home Page
  - oracle.com/technology/products/database/asm
  - Arup Nanda's articles particularly helpful
- www.idevelopment.info
  - Jeff Hunter's home page
  - Cookbook how-to examples
- Oracle10g Administrator's Guide
  - Chapter 12
- Oracle10g Installation Guide for your platform
  - Recommended reading to get up and running

Q & A

Thank You

- ***Thank you for coming to the presentation!***
- ***Thanks to SEOUC for inviting me to speak!***