Introducing Automatic Storage Management (ASM)

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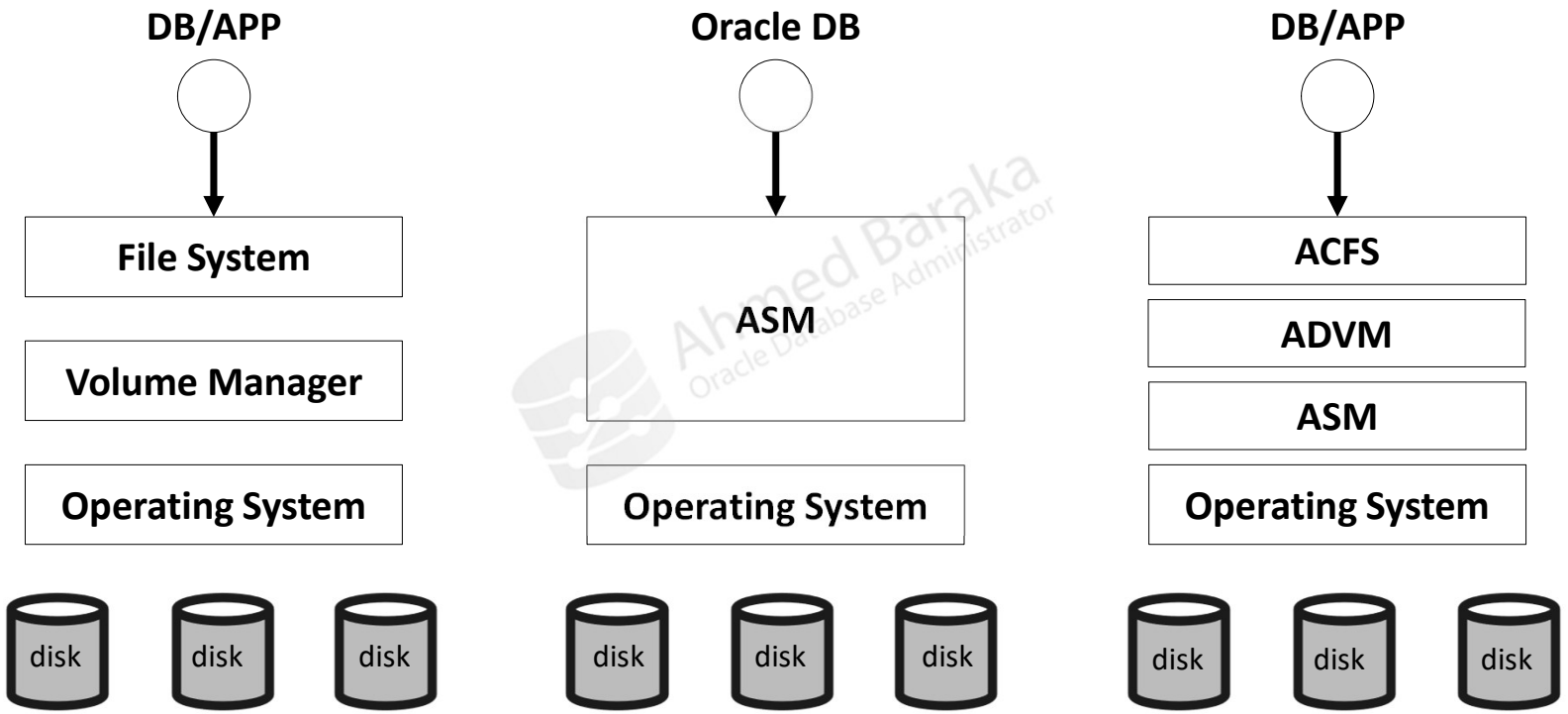
Objectives

In this lecture, you will learn how to perform the following:

- Describe the ASM and its benefits
- Describe and install Oracle Restart
- Describe ASM Disk Groups and ASM Disks
- Use ASM system privileges
- Start and stop Components managed by Oracle Restart
- Create a tablespace datafile in an ASM Disk group
- Describe and use **`asmcmd`** utility
- Migrate an existing database to ASM storage

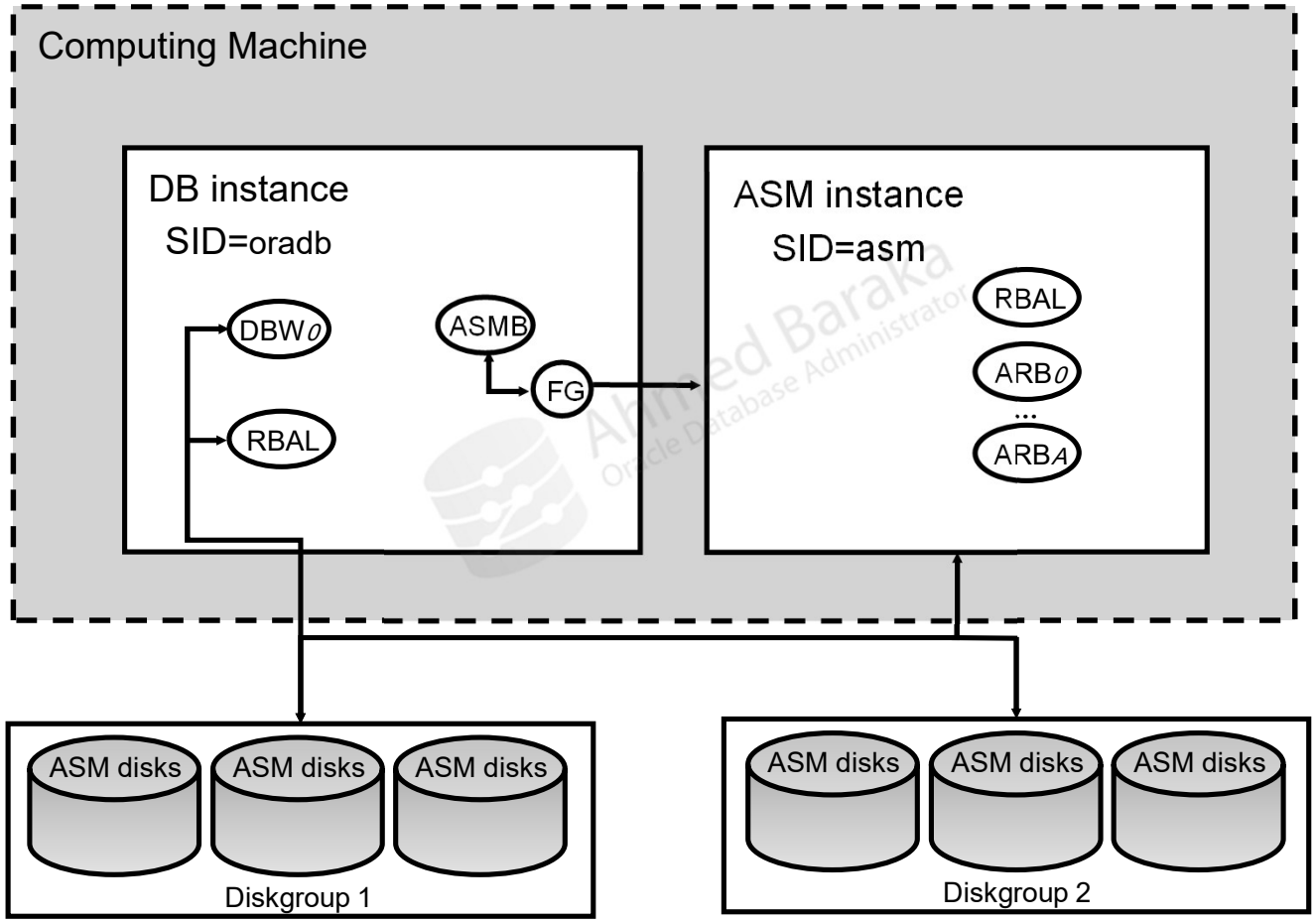
Automatic Storage Management Review



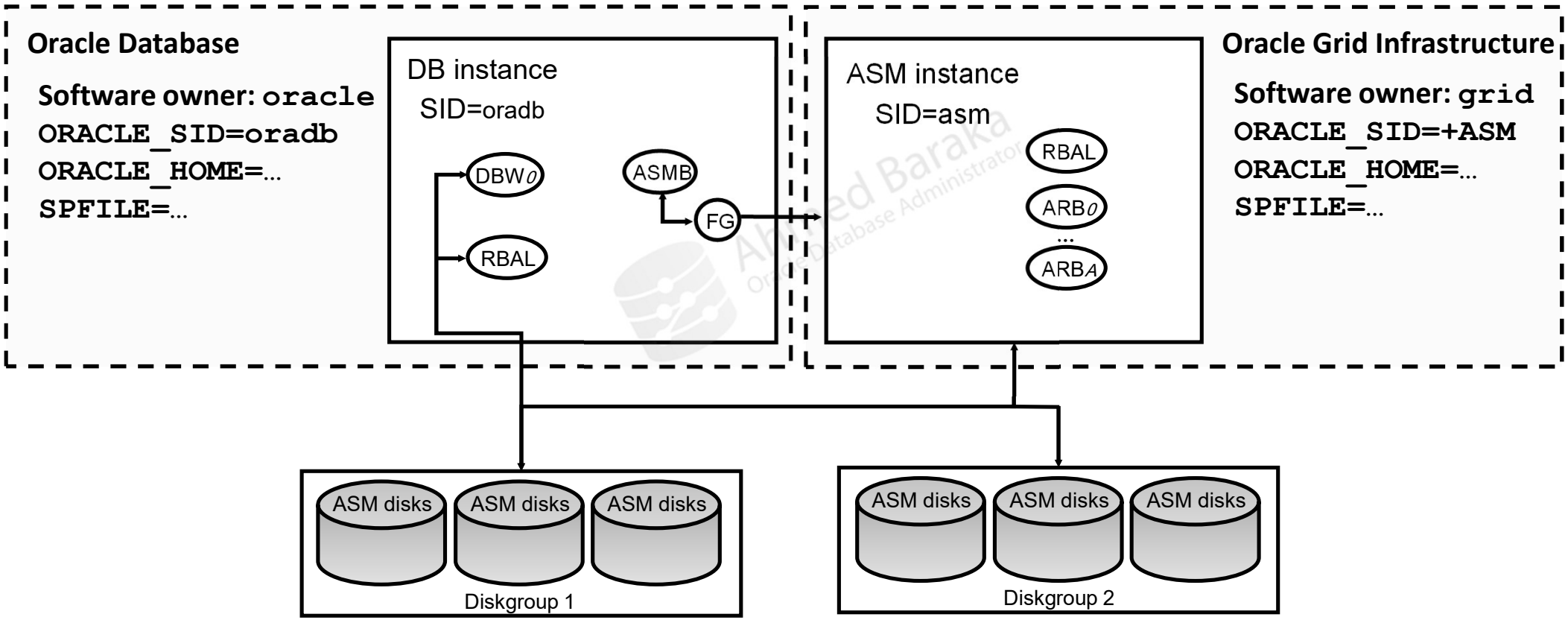
About Automatic Storage Management (ASM)

- Is a volume manager and a file system for Oracle database files
- **Pros**:
  - Supports the disk volume management features: striping, disk mirroring, and dynamic rebalancing
  - Introduces slight performance gain for Oracle databases comparing to the traditional volume management solutions
  - The best option for Oracle RAC storage
  - Supports ACFS to allow storing non-Oracle database files
- **Cons**:
  - Causes more stress on the machine resources
  - Could introduce more overhead on the DBAs

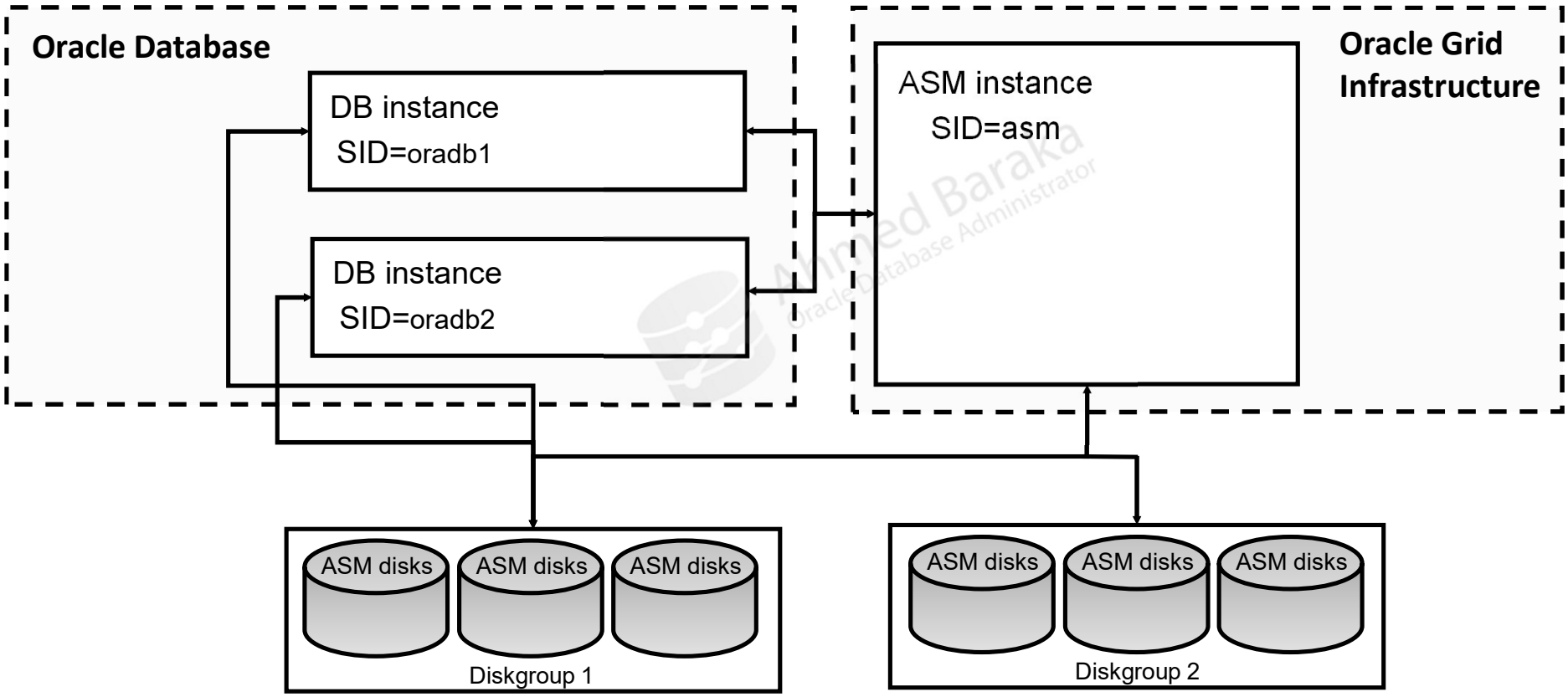
ASM General Architecture



ASM General Architecture



ASM General Architecture



More About ASM

- Oracle Grid Infrastructure should be installed first
  - Dedicate a separate software owner (**`grid`**)
- The listener is typically running from the Grid home
- Normally used in Oracle database RAC and RAC One Node
- Can be installed for a non-RAC database (**Oracle Restart)**
  - Oracle grid takes control on the sequence of starting the services

About Configuring Oracle Restart

- Oracle Restart is used in standalone server (non-clustered) environments only.
- Oracle Restart runs out of the Oracle Grid Infrastructure home
- Automatic startup of the components in the correct order: Disk groups > ASM > Listener > Database
- Resource are monitored and automatically restarted (if any fails)
- Same RAC management utilities (**`crsctl`** and **`srvctl`**) are used
- Can be configured without ASM
- You are permitted to use Grid Infra components only in the Oracle Database for which you have purchased licenses

Installing ASM for non-RAC Database (Oracle Restart)

1. Configure OS for Oracle Grid Infrastructure
2. Configure OS users, groups and environment variables
3. Configure storage for Oracle Grid Infrastructure
   - Supported storage options: local FS, NFS, DAS, OCFS2, shared disk partitions (restrictions apply)
4. Install Oracle Grid Infrastructure software and create ASM instance

- **Reference**: Oracle Grid Infrastructure Grid Infrastructure Installation and Upgrade Guide (different platforms)

ASM Configuration Files

- A server parameter file (SPFILE)
- **`orapw+ASM`** the password file
- Node listener configuration files include:
  - **`listener.ora`**
  - listener options
- **`/etc/oratab`** lists all the instances on the host machine
- **`/etc/oraInst.loc`** defines the Oracle inventory directory

ASM SPFILE Sample

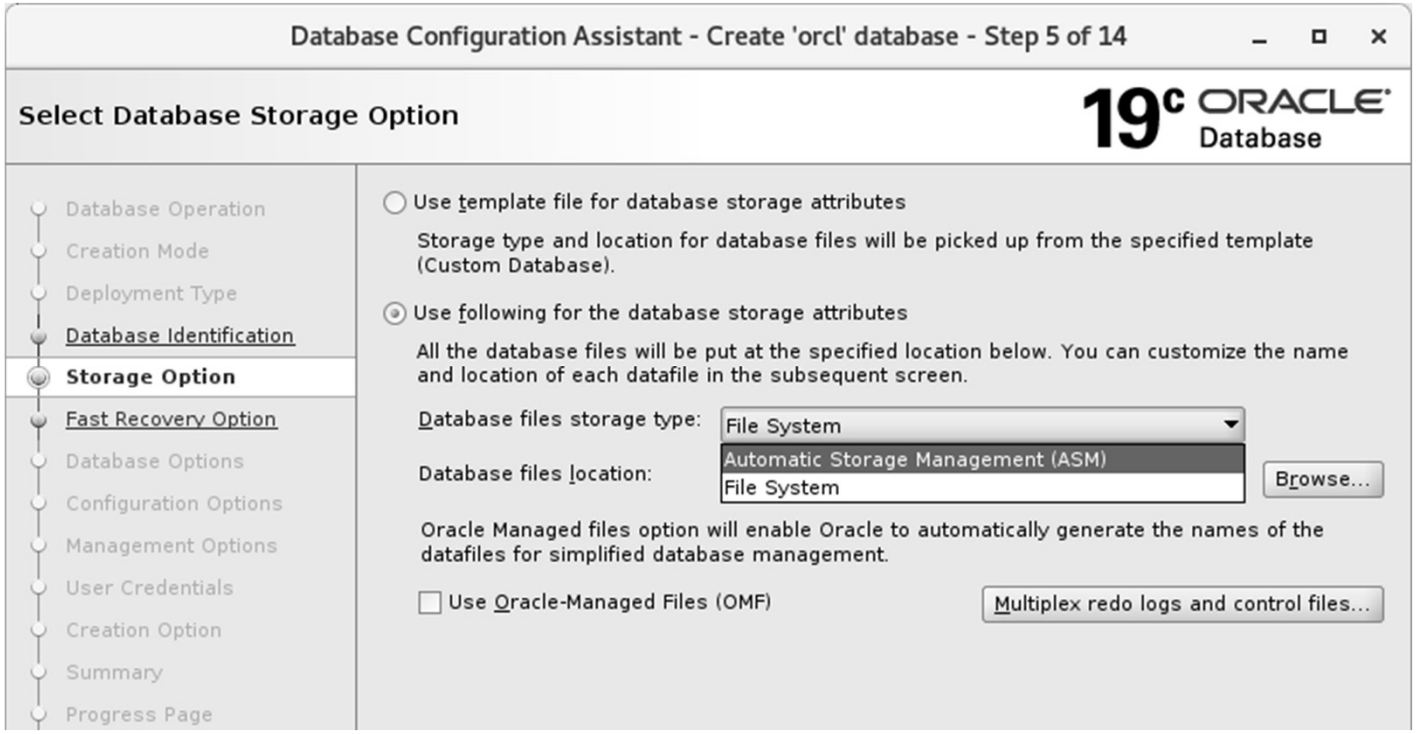
Paramater	Description
INSTANCE_TYPE	Should be ASM (It is set to RDBMS in database instances)
ASM_POWER_LIMIT	Rebalance speed
ASM_DISKSTRING	String(s) that limits the set of disks that an Oracle ASM instance discovers
ASM_DISKGROUPS	Disk discovery path

```
INSTANCE_TYPE = ASM
ASM_POWER_LIMIT = 1
ASM_DISKSTRING = '/dev/sdb*'
ASM_DISKGROUPS = DATA, FRA
DIAGNOSTIC_DEST = /u01/app/oracle
LARGE_POOL_SIZE = 12M
REMOTE_LOGIN_PASSWORDFILE = EXCLUSIVE
```

Managing ASM Instances

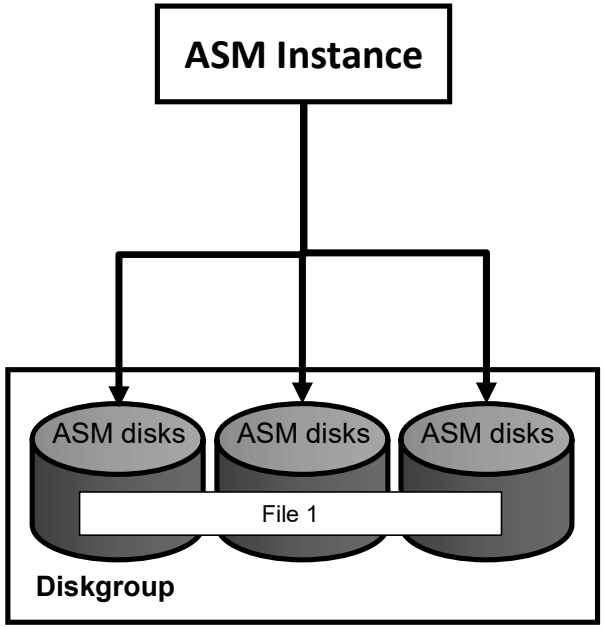
- ASM Configuration Assistant (`asmca`)
- SQL*Plus
- ASM Command-line Utility (`asmcmd`)
- `srvctl`
- Oracle Enterprise Manager Cloud Control

DBCA and Storage Options



About ASM Disk Groups

- A pool of disks managed as a logical unit
- Partitions total disk space into uniform sized units (AU)
- Spreads each file evenly across all disks using **coarse** stripping (1M AU)
- Log files saved in fine stripping group (128K)
- Supports 3 redundancy levels:
  - **Normal**: 2-way mirroring
  - **High**: internal 3-way mirroring
  - **External**: relies on third-party mirroring like RAID

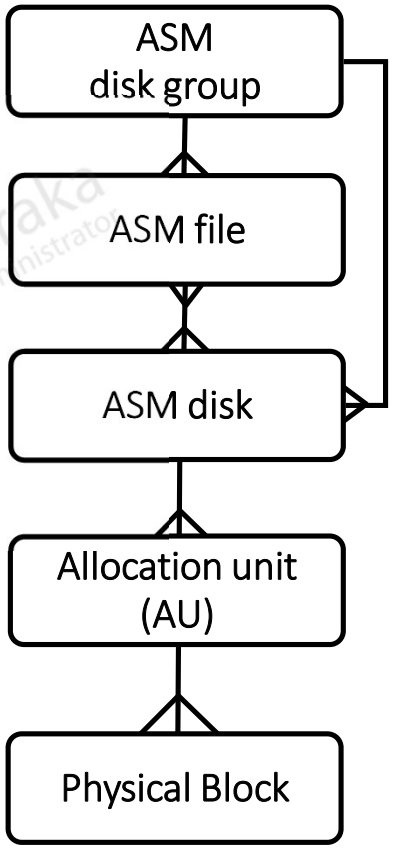


ASM Disks

- Can be formed from any of the following sources:
  - A disk or partition from a storage array
  - An entire physical disk or partitions of a physical disk
  - Logical volumes (LV) or logical units (LUN)
  - Network-Attached Files (NFS)
  - Exadatagrid disk
- Are divided into allocation units (AU) of sizes: 1,2,4,8,16,32, or 64 M
- Each file extent is allocated to a single ASM disk

ASM Storage Components Hierarchy

```
+DATA/oradb/datafile/users.256.123456789
```



ASM System Privileges

- To connect to ASM, use one of the following administratvie privileges:

Privilege	OUI Group	Group	Description
SYSASM	OSASM	asmadmin	Full administrative privilege
SYSDBA	OSDBA	asmdba	Access to data stored on ASM, and SYSASM in the current release
SYSOPER	OSOPER	asmoper	Limited privileges to start and stop the ASM instance along with a set of nondestructive ALTER DISKGROUP commands

- **SYS** is automatically created with the **SYSASM** privilege.

Accessing ASM Instance Examples

- After setting the variables, local connection using OS authentication:

```
sqlplus / as sysasm
sqlplus / as sysoper
```

- Local connection using password file authentication:

```
sqlplus sys/ABcd##1234 AS SYSASM
```

- Remote connection using Oracle Net Services and password authentication:

```
sqlplus sys/abc123@asm1 AS SYSASM
```

  - **REMOTE_LOGIN_PASSWORDFILE** must be set to a value other than **NONE** to enable remote password-based authentication.

Components Managed by the Grid Infrastructure

- Components under control of Oracle High Availability Service Daemon (OHASD) are:
  - ASM Instance
  - ASM Disk Groups
  - Listeners
  - Database Instances
  - Database Services

Starting Up an ASM Instance

- Login as **grid** and set **ORACLE_HOME** and **ORACLE_SID** must be set
- Using SQL*Plus use **STARTUP** command:

```
STARTUP [ MOUNT | OPEN | FORCE | NOMOUNT | RESTRICT ]
```

- Using **srvctl** utility:

```
srvctl start asm [-o force | mount | open | nomount | restrict ]
```

Option	Description
MOUNT OPEN	(default) Mounts the disk groups specified in the ASM_DISKGROUPS initialization parameter.
FORCE	Issues a SHUTDOWN ABORT to the ASM instance before restarting it
NOMOUNT	Starts up the ASM instance without mounting any disk groups
RESTRICT	The database instances cannot use the disk groups. Other ASM instance cannot mount the disk groups. Can be used with other options (except FORCE).

Shutting Down an ASM Instance

- Using SQL*Plus, you can use **SHUTDOWN** command:

```
SHUTDOWN { [ NORMAL | IMMEDIATE | TRANSACTIONAL | ABORT ] }
```

- Using **srvctl** utility:

```
srvctl stop asm [-o NORMAL | IMMEDIATE | TRANSACTIONAL | ABORT ] -f
```

- With clean shutdown, if a database is connected, an error is returned:
  `ORA-15097: cannot SHUTDOWN ASM instance with connected RDBMS instance`
- With **ABORT** option, the ASM shuts down and the connected database will eventually shuts down reporting the following error:
  `ORA-15064: communication failure with ASM instance`

ASM Shutdown Options

Option	Description
NORMAL	(default) Wait for users currently connected to the ASM. If a database instance is connected, an error is returned.
IMMEDIATE TRANSACTIONAL	Wait for any ongoing SQL processes to finish before dismounting all the disk groups and shutting down. Do not wait for users currently connected to the instance to disconnect. If there are any database instances connected to the ASM, return an error.
ABORT	Immediately shut down the ASM instance without properly dismounting the disk groups. If there are any database instances connected to the ASM, then the database instances will also abort.

- It is highly recommended to shutdown the database instances before shutting down the ASM instance

Starting and Stopping Components Managed by Oracle Restart

- To startup a database instance:

```
srvctl start database -d $ORACLE_SID [ -O MOUNT | OPEN | FORCE |
NOMOUNT | RESTRICT ]
```

- To shutdown the database instance:

```
srvctl stop database -d $ORACLE_SID [-o NORMAL | IMMEDIATE |
TRANSACTIONAL | ABORT ]
```

- To checkout the status of the database:

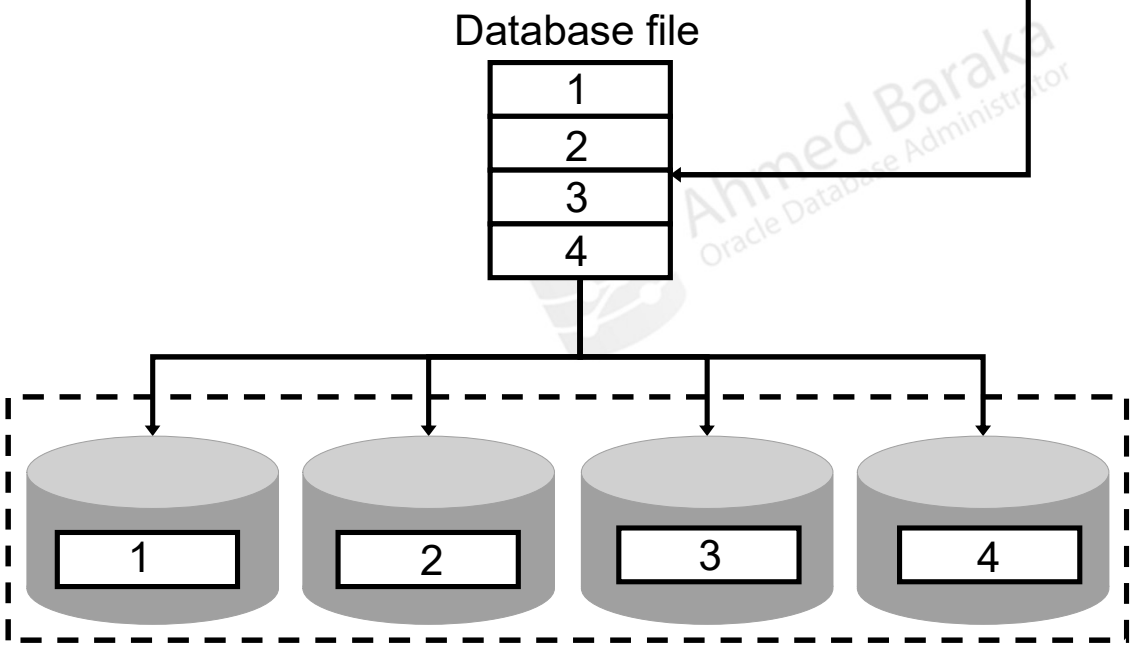
```
srvctl status database -d $ORACLE_SID
```

- To startup or shut down the listener:

```
srvctl start listener
srvctl stop listener
```

Creating Tablespace Datafile in ASM Diskgroup

```
CREATE TABLESPACE mytbs DATAFILE '+DATA';
```



ASM file automatically spread inside disk group `DATA`

About ASMCMD Utility

- A command-line utility to manipulate the directories and files in ASM using OS-like commands
- Commands can be run in interactive and non-interactive modes
- Following are some common commands:

Command	Description
`pwd`	Displays the absolute path of the current directory
`cd`	Change the current directory
`find`	Finds under a specified directory all paths that match a given pattern
`ls`	Lists aliases or its contents
`mkdir`	Make a directory
`rm`	Delete a file or a directory

ASMCMD Utility More Commands

Command	Description
mkalias	Creates the specified user alias for specified system alias
rmalias	Deletes the specified user aliases while preserving the files and their system aliases
du	Displays the total space used by files located recursively under the specified directory
lsdg	Lists all diskgroups and their attributes
lsct	Lists all clients and their attributes
lsdsk	Lists the disks that are visible to ASM
cp	Used to copy files between ASM disk groups on local instances to and from remote instances. `cp +dg1/vdb.ctf1 /backups/vdb.ctf1`
help	Displays list of supported commands

Obtaining Information about ASM from SQL

Privilege	Description
V$ASM_DISKGROUP	Retrieves information about discovered disk groups
V$ASM_DISKGROUP_STAT	Same as **V$ASM_DISKGROUP** but without new disk groups
V$ASM_FILE	Displays information about the files in each disk group
V$ASM_OPERATION	Retrieves information about long running operations executed by ASM
V$ASM_DISK	Retrieves information about the disks discovered by ASM
V$ASM_DISK_STAT	Same as **V$ASM_DISK** but without new disks
V$ASM_DISK_IOSTAT	Displays information about disk I/O statistics for ASM client
V$ASM_CLIENT	Identifies the databases using the disk groups

- More **V$ASM_*** views are available.

Migrating Your Database to ASM Storage

- **Target**: migrate all the database files (and FRA) to ASM disk groups
- **Challenge**: move non-ASM files to ASM disk groups. The only capable tool is RMAN
- **Requirements**:
  - If flashback database is enabled, disable it
  - If block change tracking is enabled, then disable it
  - Make one RMAN database backup as copy into ASM:

```
RMAN> BACKUP AS COPY INCREMENTAL LEVEL 0 DATABASE
FORMAT '+DATA' TAG 'ORA_ASM_MIGRATION';
```

Migrating Your Database to ASM Storage

1. Obtain current file names of the control files and redo log files
2. Shut down the database cleanly (consistently)
3. Mount the database and restore **SPFILE** into the ASM disk group:

```
RMAN> STARTUP MOUNT;
RMAN> RESTORE SPFILE TO '+DATA/oradata/oradb/spfilesid.ora';
```

4. Set the **DB_CREATE_FILE_DEST** (OMF) and optional **DB_CREATE_ONLINE_LOG_DEST_n** parameters to ASM disk groups
5. (Optional) Set **DB_RECOVERY_FILE_DEST** (FRA) to a disk group

```
SQL> ALTER SYSTEM SET DB_CREATE_FILE_DEST='+RECO';
```

Migrating Your Database to ASM Storage

6. Set the **CONTROL_FILES** parameter to Oracle ASM locations

```
SQL> STARTUP FORCE NOMOUNT;
SQL> ALTER SYSTEM SET CONTROL_FILES='+DATA','+FRA' SCOPE=SPFILE;
```

7. Restore the control files into the new location:

```
RMAN> STARTUP FORCE NOMOUNT;
RMAN> RESTORE CONTROLFILE FROM '<original-controlfile-name>';
RMAN> ALTER DATABASE MOUNT;
```

8. Switch the data files to the backup image copies:

```
SWITCH DATABASE TO COPY;
RECOVER DATABASE;
```

9. If needed, enable flashback database and BCT features

Migrating Your Database to ASM Storage

10. Open the database in normal operation mode

```
SQL> ALTER DATABASE OPEN;
```

11. Drop the tempfiles and re-create them in Oracle ASM

```
SQL> ALTER DATABASE TEMPFILE 'tempfile_name' DROP;
SQL> ALTER TABLESPACE temp_tbs_name ADD TEMPFILE;
```

12. Migrate the online redo log files
    - Add new log group members in Oracle ASM and drop the old members.

References

- Automatic Storage Management Administrators Guide
- Oracle Grid Infrastructure Grid Infrastructure Installation and Upgrade Guide (different platforms)
- Oracle Clusterware Administration and Deployment Guide

Should We go with Oracle Restart?

Summary

In this lecture, you should have learnt how to perform the following:

- Describe the ASM and its benefits
- Describe and install Oracle Restart
- Describe ASM Disk Groups and ASM Disks
- Use ASM system privileges
- Start and stop Components managed by Oracle Restart
- Create a tablespace datafile in an ASM Disk group
- Describe and use **`asmcmd`** utility
- Migrate an existing database to ASM storage