Oracle ASM Cluster File Systems (ACFS) in Oracle Database 11Gr2

# ACFS Prerequisites

## Install Oracle Grid Infrastructure

## Log In as the Grid Infrastructure User

|  |
| --- |
| [grid@racnode1 ~]$ **id**  uid=1100(grid) gid=1000(oinstall) groups=1000(oinstall),1200(asmadmin),1201(asmdba),1202(asmoper)  [grid@racnode1 ~]$ **. oraenv**  ORACLE\_SID = [+ASM1] ? **+ASM1**  The Oracle base for ORACLE\_HOME=/u01/app/11.2.0/grid is /u01/app/grid  [grid@racnode1 ~]$ **dbhome**  /u01/app/11.2.0/grid  [grid@racnode1 ~]$ **echo $ORACLE\_SID**  +ASM1 |

## Verify / Create ASM Disk Group

Using ASMCA for easy use

## Verify Oracle ASM Volume Driver

The operating environment used in this guide is CentOS 5.5 x86\_64:

|  |
| --- |
| [root@racnode1 ~]# **uname -a**  Linux racnode1 2.6.18-194.el5 #1 SMP Fri Apr 2 14:58:14 EDT 2010 x86\_64 x86\_64 x86\_64 GNU/Linux |
| [root@racnode1 ~]# **/u01/app/11.2.0/grid/bin/acfsload start -s**  acfsload: ACFS-9129: ADVM/ACFS not installed |

To install ADVM/ACFS, copy the following kernel modules from the Oracle Grid Infrastructure home to the expected location:

|  |
| --- |
| [root@racnode1 ~]# **mkdir /lib/modules/2.6.18-194.el5/extra/usm**  [root@racnode1 ~]# **cd /u01/app/11.2.0/grid/install/usm/EL5/x86\_64/2.6.18-8/2.6.18-8.el5-x86\_64/bin**  [root@racnode1 bin]# **cp \*ko /lib/modules/2.6.18-194.el5/extra/usm/**  [root@racnode2 ~]# **mkdir /lib/modules/2.6.18-194.el5/extra/usm**  [root@racnode2 ~]# **cd /u01/app/11.2.0/grid/install/usm/EL5/x86\_64/2.6.18-8/2.6.18-8.el5-x86\_64/bin**  [root@racnode2 bin]# **cp \*ko /lib/modules/2.6.18-194.el5/extra/usm/** |

Once the kernel modules have been copied, we can verify the ADVM/ACFS installation by running the following from all Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **cd /u01/app/11.2.0/grid/bin**  [root@racnode1 bin]# **./acfsdriverstate -orahome /u01/app/11.2.0/grid version**  ACFS-9205: OS/ADVM,ACFS installed version = 2.6.18-8.el5(x86\_64)/090715.1  [root@racnode2 ~]# **cd /u01/app/11.2.0/grid/bin**  [root@racnode2 bin]# **./acfsdriverstate -orahome /u01/app/11.2.0/grid version**  ACFS-9205: OS/ADVM,ACFS installed version = 2.6.18-8.el5(x86\_64)/090715.1 |

The next step is to record dependencies for the new kernel modules:

|  |
| --- |
| [root@racnode1 ~]# **depmod**  [root@racnode2 ~]# **depmod** |

Next, copy the Oracle ACFS executables to /sbin and set the appropriate permissions. The Oracle ACFS executables are located in theGRID\_HOME/install/usm/EL5/<ARCHITECTURE>/<KERNEL\_VERSION>/<FULL\_KERNEL\_VERSION>/bin directory or in the /u01/app/11.2.0/grid/install/usm/cmds/bin directory (12 files) and include any file without the\*.ko extension:

|  |
| --- |
| [root@racnode1 ~]# **cd /u01/app/11.2.0/grid/install/usm/EL5/x86\_64/2.6.18-8/2.6.18-8.el5-x86\_64/bin**  [root@racnode1 bin]# **cp acfs\* /sbin; chmod 755 /sbin/acfs\***  [root@racnode1 bin]# **cp advmutil\* /sbin; chmod 755 /sbin/advmutil\***  [root@racnode1 bin]# **cp fsck.acfs\* /sbin; chmod 755 /sbin/fsck.acfs\***  [root@racnode1 bin]# **cp mkfs.acfs\* /sbin; chmod 755 /sbin/mkfs.acfs\***  [root@racnode1 bin]# **cp mount.acfs\* /sbin; chmod 755 /sbin/mount.acfs\***  [root@racnode1 ~]# **cd /u01/app/11.2.0/grid/install/usm/cmds/bin**  [root@racnode1 bin]# **cp acfs\* /sbin; chmod 755 /sbin/acfs\***  [root@racnode1 bin]# **cp advmutil\* /sbin; chmod 755 /sbin/advmutil\***  [root@racnode1 bin]# **cp fsck.acfs\* /sbin; chmod 755 /sbin/fsck.acfs\***  [root@racnode1 bin]# **cp mkfs.acfs\* /sbin; chmod 755 /sbin/mkfs.acfs\***  [root@racnode1 bin]# **cp mount.acfs\* /sbin; chmod 755 /sbin/mount.acfs\***  -----------------------------------------------------------------------------  [root@racnode2 ~]# **cd /u01/app/11.2.0/grid/install/usm/EL5/x86\_64/2.6.18-8/2.6.18-8.el5-x86\_64/bin**  [root@racnode2 bin]# **cp acfs\* /sbin; chmod 755 /sbin/acfs\***  [root@racnode2 bin]# **cp advmutil\* /sbin; chmod 755 /sbin/advmutil\***  [root@racnode2 bin]# **cp fsck.acfs\* /sbin; chmod 755 /sbin/fsck.acfs\***  [root@racnode2 bin]# **cp mkfs.acfs\* /sbin; chmod 755 /sbin/mkfs.acfs\***  [root@racnode2 bin]# **cp mount.acfs\* /sbin; chmod 755 /sbin/mount.acfs\***  [root@racnode2 ~]# **cd /u01/app/11.2.0/grid/install/usm/cmds/bin**  [root@racnode2 bin]# **cp acfs\* /sbin; chmod 755 /sbin/acfs\***  [root@racnode2 bin]# **cp advmutil\* /sbin; chmod 755 /sbin/advmutil\***  [root@racnode2 bin]# **cp fsck.acfs\* /sbin; chmod 755 /sbin/fsck.acfs\***  [root@racnode2 bin]# **cp mkfs.acfs\* /sbin; chmod 755 /sbin/mkfs.acfs\***  [root@racnode2 bin]# **cp mount.acfs\* /sbin; chmod 755 /sbin/mount.acfs\*** |

Now, running acfsload start -s will complete without any further messages:

|  |
| --- |
| [root@racnode1 ~]# **/u01/app/11.2.0/grid/bin/acfsload start -s**  [root@racnode2 ~]# **/u01/app/11.2.0/grid/bin/acfsload start -s** |

Check that the modules were successfully loaded on all Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **lsmod | grep oracle**  oracleacfs 877320 4  oracleadvm 221760 8  oracleoks 276880 2 oracleacfs,oracleadvm  oracleasm 84136 1  [root@racnode2 ~]# **lsmod | grep oracle**  oracleacfs 877320 4  oracleadvm 221760 8  oracleoks 276880 2 oracleacfs,oracleadvm  oracleasm 84136 1 |

Configure the Oracle ASM volume driver to load automatically on system startup on all Oracle RAC nodes. You will need to create an initialization script (/etc/init.d/acfsload) that contains the runlevel configuration and theacfsload command. Change the permissions on the /etc/init.d/acfsload script to allow it to be executed by root and then create links in the rc2.d, rc3.d, rc4.d, and rc5.d runlevel directories using 'chkconfig --add':

|  |
| --- |
| [root@racnode1 ~]# **chkconfig --list | grep acfsload**  [root@racnode2 ~]# **chkconfig --list | grep acfsload**  =======================================================  [root@racnode1 ~]# **cat > /etc/init.d/acfsload <<EOF**  **#!/bin/sh**  **# chkconfig: 2345 30 21**  **# description: Load Oracle ASM volume driver on system startup**  **ORACLE\_HOME=/u01/app/11.2.0/grid**  **export ORACLE\_HOME**  **\$ORACLE\_HOME/bin/acfsload start -s**  **EOF**  [root@racnode2 ~]# **cat > /etc/init.d/acfsload <<EOF**  **#!/bin/sh**  **# chkconfig: 2345 30 21**  **# description: Load Oracle ASM volume driver on system startup**  **ORACLE\_HOME=/u01/app/11.2.0/grid**  **export ORACLE\_HOME**  **\$ORACLE\_HOME/bin/acfsload start -s**  **EOF**  =======================================================  [root@racnode1 ~]# **chmod 755 /etc/init.d/acfsload**  [root@racnode2 ~]# **chmod 755 /etc/init.d/acfsload**  =======================================================  [root@racnode1 ~]# **chkconfig --add acfsload**  [root@racnode2 ~]# **chkconfig --add acfsload**  =======================================================  [root@racnode1 ~]# **chkconfig --list | grep acfsload**  acfsload 0:off 1:off 2:on 3:on 4:on 5:on 6:off  [root@racnode2 ~]# **chkconfig --list | grep acfsload**  acfsload 0:off 1:off 2:on 3:on 4:on 5:on 6:off |

If the Oracle Grid Infrastructure 'ora.registry.acfs' resource does not exist, create it. This only needs to be performed from one of the Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **su - grid -c crs\_stat | grep acfs**  [root@racnode2 ~]# **su - grid -c crs\_stat | grep acfs**  =======================================================  [root@racnode1 ~]# **/u01/app/11.2.0/grid/bin/crsctl add type ora.registry.acfs.type \**  **-basetype ora.local\_resource.type \**  **-file /u01/app/11.2.0/grid/crs/template/registry.acfs.type**  [root@racnode1 ~]# **/u01/app/11.2.0/grid/bin/crsctl add resource ora.registry.acfs \**  **-attr ACL=\'owner:root:rwx,pgrp:oinstall:r-x,other::r--\' \**  **-type ora.registry.acfs.type -f**  =======================================================  [root@racnode1 ~]# **su - grid -c crs\_stat | grep acfs**  NAME=ora.registry.acfs  TYPE=ora.registry.acfs.type  [root@racnode2 ~]# **su - grid -c crs\_stat | grep acfs**  NAME=ora.registry.acfs  TYPE=ora.registry.acfs.type |

As a final step, modify any of the Oracle ACFS shell scripts copied to the /sbin directory (above) to include the ORACLE\_HOME for Grid Infrastructure. The successful execution of these scripts requires access to certain Oracle shared libraries that are found in the Grid Infrastructure Oracle home. Since many of the Oracle ACFS shell scripts will be executed as the root user account, the ORACLE\_HOME environment variable will typically not be set in the shell and will result in the executable to fail. For example:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/acfsutil registry**  /sbin/acfsutil.bin: error while loading shared libraries: libhasgen11.so:  cannot open shared object file: No such file or directory |

An easy workaround to get past this error is to set the ORACLE\_HOME environment variable for the Oracle Grid Infrastructure home in the Oracle ACFS shell scripts on all Oracle RAC nodes. The ORACLE\_HOME should be set at the beginning of the file after the header comments as shown in the following example:

|  |
| --- |
| #!/bin/sh  #  # Copyright (c) 2001, 2009, Oracle and/or its affiliates. All rights reserved.  #  **ORACLE\_HOME=/u01/app/11.2.0/grid**  ORA\_CRS\_HOME=%ORA\_CRS\_HOME%  if [ ! -d $ORA\_CRS\_HOME ]; then  ORA\_CRS\_HOME=$ORACLE\_HOME  fi  ... |

Add the ORACLE\_HOME environment variable for the Oracle Grid Infrastructure home as noted above to the following Oracle ACFS shell scripts on all Oracle RAC nodes:

* /sbin/acfsdbg
* /sbin/acfsutil
* /sbin/advmutil
* /sbin/fsck.acfs
* /sbin/mkfs.acfs
* /sbin/mount.acfs

## Verify ASM Disk Group Compatibility Level

The compatibility level for the Oracle ASM disk group must be at least 11.2 in order to create an Oracle ASM volume. From the Oracle ASM instance, perform the following checks:

|  |
| --- |
| SQL> **SELECT compatibility, database\_compatibility**  2 **FROM v$asm\_diskgroup**  3 **WHERE name = 'DOCSDG1';**  COMPATIBILITY DATABASE\_COMPATIBILITY  ---------------- -----------------------  10.1.0.0.0 10.1.0.0.0 |

If the results show something other than 11.2 or higher (as the above example shows), we need to set the compatibility to at least 11.2 by issuing the following series of SQL statements from the Oracle ASM instance:

|  |
| --- |
| [grid@racnode1 ~]$ **sqlplus / as sysasm**  SQL> **ALTER DISKGROUP docsdg1 SET ATTRIBUTE 'compatible.asm' = '11.2';**  Diskgroup altered.  SQL> **ALTER DISKGROUP docsdg1 SET ATTRIBUTE 'compatible.rdbms' = '11.2';**  Diskgroup altered.  SQL> **ALTER DISKGROUP docsdg1 SET ATTRIBUTE 'compatible.advm' = '11.2';**  Diskgroup altered. |

Verify the changes to the compatibility level:

|  |
| --- |
| SQL> **SELECT compatibility, database\_compatibility**  2 **FROM v$asm\_diskgroup**  3 **WHERE name = 'DOCSDG1';**  COMPATIBILITY DATABASE\_COMPATIBILITY  ---------------- -----------------------  11.2.0.0.0 11.2.0.0.0 |

# Create ACFS using ASMCA

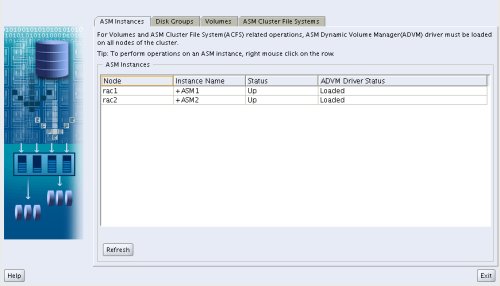
## Create Mount Point

From each Oracle RAC node, create a directory that will be used to mount the new Oracle ACFS:

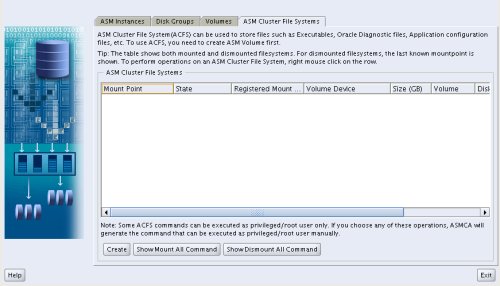
|  |
| --- |
| [root@racnode1 ~]# **mkdir /documents1**  [root@racnode2 ~]# **mkdir /documents1** |

## Create ASM Cluster File System

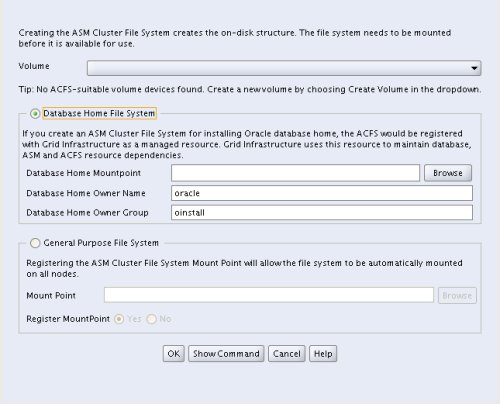
* + When the ASM configuration assistant starts you are presented with the "ASM Instances"



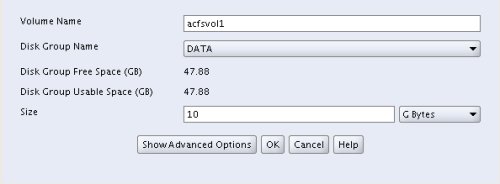
* + Click on the "ASM Cluster File Systems" tab, then click the "Create" button.



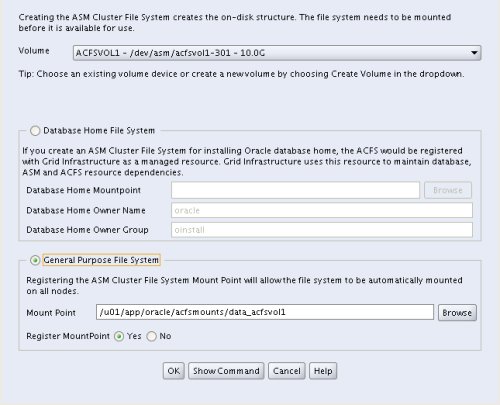
* + Select "Create Volume" from the Volume list.



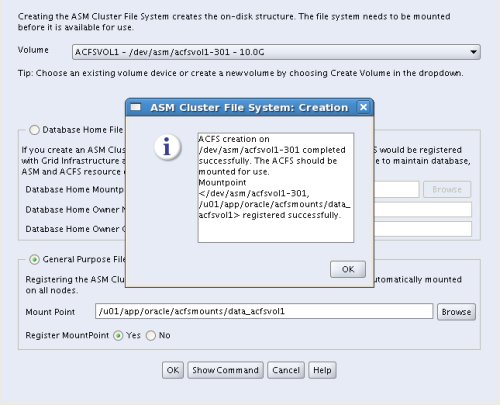
* + Enter the Volume Name and Size and click the "OK" button. Wait for the volume to be created, then click the "OK" button on the subsequent message dialog.



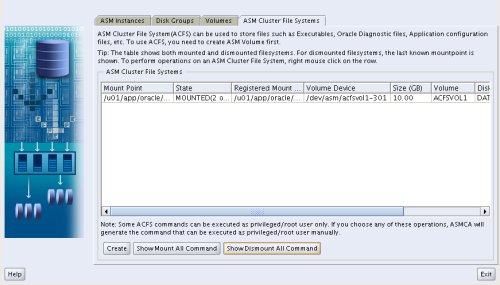
* + The newly created volume will now be selected in the Volume list. Select the "General Purpose File System" option, enter a previously created mount point directory (or leave the suggested mount point), select the "Yes" option for Register MountPoint and click the "OK" button.



* + Click the "OK" button on the resulting message.



* + The newly created cluster file system is now listed under the "ASM Cluster File Systems" tab.



## Mount the New Cluster File System

Now that the new Oracle ASM cluster file system has been created and registered in the Oracle ACFS mount registry, log in to all Oracle RAC nodes as root and run the following mount command:

|  |
| --- |
| [root@racnode1 ~]# **/bin/mount -t acfs /dev/asm/docsvol1-300 /documents1**  [root@racnode2 ~]# **/bin/mount -t acfs /dev/asm/docsvol1-300 /documents1** |

## Verify Mounted Cluster File System

To verify that the new cluster file system mounted properly, run the following mount command from all Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **mount**  /dev/mapper/VolGroup00-LogVol00 on / type ext3 (rw)  proc on /proc type proc (rw)  sysfs on /sys type sysfs (rw)  devpts on /dev/pts type devpts (rw,gid=5,mode=620)  /dev/sdb1 on /local type ext3 (rw)  /dev/sda1 on /boot type ext3 (rw)  tmpfs on /dev/shm type tmpfs (rw)  none on /proc/sys/fs/binfmt\_misc type binfmt\_misc (rw)  sunrpc on /var/lib/nfs/rpc\_pipefs type rpc\_pipefs (rw)  domo:PUBLIC on /domo type nfs (rw,addr=192.168.1.121)  oracleasmfs on /dev/oracleasm type oracleasmfs (rw)  /dev/asm/docsvol1-300 on /documents1 type acfs (rw)  [root@racnode2 ~]# **mount**  /dev/mapper/VolGroup00-LogVol00 on / type ext3 (rw)  proc on /proc type proc (rw)  sysfs on /sys type sysfs (rw)  devpts on /dev/pts type devpts (rw,gid=5,mode=620)  /dev/sdb1 on /local type ext3 (rw)  /dev/sda1 on /boot type ext3 (rw)  tmpfs on /dev/shm type tmpfs (rw)  none on /proc/sys/fs/binfmt\_misc type binfmt\_misc (rw)  sunrpc on /var/lib/nfs/rpc\_pipefs type rpc\_pipefs (rw)  domo:Public on /domo type nfs (rw,addr=192.168.1.121)  oracleasmfs on /dev/oracleasm type oracleasmfs (rw)  /dev/asm/docsvol1-300 on /documents1 type acfs (rw) |

## Set Permissions

Run the following as root from only one node in the Oracle RAC:

|  |
| --- |
| [root@racnode1 ~]# **chown oracle.dba /documents1**  [root@racnode1 ~]# **chmod 775 /documents1** |

## Register New Volume

Use the /sbin/acfsutil utility on only one of Oracle RAC nodes to register the new mount point in the Oracle ACFS mount registry:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/acfsutil registry -f -a /dev/asm/docsvol3-300 /documents3**  acfsutil registry: mount point /documents3 successfully added to Oracle Registry |

Query the Oracle ACFS mount registry from all Oracle RAC nodes to verify the volume and mount point was successfully registered:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/acfsutil registry**  Mount Object:  Device: /dev/asm/docsvol1-300  Mount Point: /documents1  Disk Group: DOCSDG1  Volume: DOCSVOL1  Options: none  Nodes: all  Mount Object:  Device: /dev/asm/docsvol2-300  Mount Point: /documents2  Disk Group: DOCSDG1  Volume: DOCSVOL2  Options: none  Nodes: all  Mount Object:  Device: /dev/asm/docsvol3-300  Mount Point: /documents3  Disk Group: DOCSDG1  Volume: DOCSVOL3  Options: none  Nodes: all |

# Manaing ACFS

## ACFS Snapshots

Oracle ASM Cluster File System includes a feature called *snapshots*. An Oracle ACFS snapshot is an online, read-only, point in time copy of an Oracle ACFS file system. The snapshot process uses *Copy-On-Write* functionality which makes efficient use of disk space. Note that snapshots work at the block level instead of the file level. Before an Oracle ACFS file extent is modified or deleted, its current value is copied to the snapshot to maintain the point-in-time view of the file system.

|  |  |  |
| --- | --- | --- |
| |  |  | | --- | --- | | http://www.idevelopment.info/images/popup_dialog_information_mark.gif | When a file is modified, only the changed blocks are copied to the snapshot location which helps conserve disk space. | |

Once an Oracle ACFS snapshot is created, all snapshot files are immediately available for use. Snapshots are always available as long as the file system is mounted. This provides support for online recovery of files inadvertently modified or deleted from a file system. You can have up to 63 snapshot views supported for each file system. This provides for a flexible online file recovery solution which can span multiple views. You can also use an Oracle ACFS snapshot as the source of a file system backup, as it can be created on demand to deliver a current, consistent, online view of an active file system. Once the Oracle ACFS snapshot is created, simply backup the snapshot to another disk or tape location to create a consistent backup set of the files.

|  |  |  |
| --- | --- | --- |
| |  |  | | --- | --- | | http://www.idevelopment.info/images/popup_dialog_information_mark.gif | Oracle ACFS snapshots can be created and deleted on demand without the need to take the file system offline. ACFS snapshots provide a point-in-time consistent view of the entire file system which can be used to restore deleted or modified files and to perform backups. | |

All storage for Oracle ACFS snapshots are maintained within the file system which eliminates the need for separate storage pools for file systems and snapshots. As shown in the [next section](http://www.idevelopment.info/data/Oracle/DBA_tips/Automatic_Storage_Management/ASM_50.shtml#Resize File System), Oracle ACFS file systems can be dynamically re-sized to accommodate addition file and snapshot storage requirements.

Oracle ACFS snapshots are administered with the acfsutil snap command. This section will provide an overview on how to create and retrieve Oracle ACFS snapshots.

### Oracle ACFS Snapshot Location

Whenever you create an Oracle ACFS file system, a hidden directory is created as a sub-directory to the Oracle ACFS file system named .ACFS. (Note that hidden files and directories in Linux start with leading period.)

|  |
| --- |
| [oracle@racnode1 ~]$ **ls -lFA /documents3**  total 2851148  drwxr-xr-x 5 root root 4096 Nov 26 17:57 .ACFS/  -rw-r--r-- 1 oracle oinstall 1239269270 Nov 27 16:02 linux.x64\_11gR2\_database\_1of2.zip  -rw-r--r-- 1 oracle oinstall 1111416131 Nov 27 16:03 linux.x64\_11gR2\_database\_2of2.zip |

Found in the .ACFS are two directories named repl and snaps. All Oracle ACFS snapshots are stored in the snaps directory.

|  |
| --- |
| [oracle@racnode1 ~]$ **ls -lFA /documents3/.ACFS**  total 12  drwx------ 2 root root 4096 Nov 26 17:57 .fileid/  drwx------ 6 root root 4096 Nov 26 17:57 repl/  drwxr-xr-x 2 root root 4096 Nov 27 15:53 snaps/ |

Since no Oracle ACFS snapshots exist, the snaps directory is empty.

|  |
| --- |
| [oracle@racnode1 ~]$ **ls -lFA /documents3/.ACFS/snaps**  total 0 |

### Create Oracle ACFS Snapshot

Let's start by creating an Oracle ACFS snapshot named **snap1** for the Oracle ACFS mounted on /documents3. This operation should be performed as root or the Oracle Grid Infrastructure owner:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/acfsutil snap create snap1 /documents3**  acfsutil snap create: Snapshot operation is complete. |

The data for the new snap1 snapshot will be stored in /documents3/.ACFS/snaps/snap1. Once the snapshot is created, any existing files and/or directories in the file system are automatically accessible from the snapshot directory. For example, when I created the snap1 snapshot, the three Oracle ZIP files were made available from the snapshot /documents3/.ACFS/snaps/snap1:

|  |
| --- |
| [oracle@racnode1 ~]$ **ls -lFA /documents3/.ACFS/snaps/snap1**  total 2851084  drwxr-xr-x 5 root root 4096 Nov 26 17:57 .ACFS/ |

It is important to note that when the snapshot gets created, nothing is actually stored in the snapshot directory, so there is no additional space consumption. The snapshot directory will only contain *modified* file blocks when a file is updated or deleted.

### Restore Files From an Oracle ACFS Snapshot

When a file is deleted (or modified), this triggers an automatic backup of all modified file blocks to the snapshot. For example, if I delete the file /documents3/linux.x64\_11gR2\_examples.zip, the previous images of the file blocks are copied to the snap1 snapshot where it can be restored from at a later time if necessary:

|  |
| --- |
| [oracle@racnode1 ~]$ **rm /documents3/linux.x64\_11gR2\_examples.zip** |

If you were looking for functionality in Oracle ACFS to perform a *rollback* of the current file system to a snapshot, then I have bad news; one doesn't exist. Hopefully this will be a feature introduced in future versions!

In the case where you accidentally deleted a file from the current file system, it can be restored by copying it from the snapshot, back to the the current file system:

|  |
| --- |
| [oracle@racnode1 ~]$ **cp /documents3/.ACFS/snaps/snap1/linux.x64\_11gR2\_examples.zip /documents3** |

### Display Oracle ACFS Snapshot Information

The '/sbin/acfsutil info fs' command can provide file system information as well as limited information on any Oracle ACFS snapshots:

|  |
| --- |
| [oracle@racnode1 ~]$ **/sbin/acfsutil info fs /documents3**  /documents3  ACFS Version: 11.2.0.1.0.0  flags: MountPoint,Available  mount time: Sat Nov 27 03:07:50 2010  volumes: 1  total size: 26843545600  total free: 23191826432  primary volume: /dev/asm/docsvol3-300  label: DOCSVOL3  flags: Primary,Available  on-disk version: 39.0  allocation unit: 4096  major, minor: 252, 153603  size: 26843545600  free: 23191826432  number of snapshots: 1  snapshot space usage: 560463872 |

From the example above, you can see that I have only one active snapshot that is consuming approximately 560MB of disk space. This coincides with the size of the file I removed earlier (/documents3/linux.x64\_11gR2\_examples.zip) which triggered a back up of all modified file image blocks.

To query all snapshots, simply list the directories under '<ACFS\_MOUNT\_POINT>/.ACFS/snaps'. Each directory under the snaps directory is an Oracle ACFS snapshot.

Another useful technique used to obtain information about Oracle ACFS snapshots is to query the view V$ASM\_ACFSSNAPSHOTS from the Oracle ASM instance:

|  |
| --- |
| column snap\_name format a15 heading "Snapshot Name"  column fs\_name format a15 heading "File System"  column vol\_device format a25 heading "Volume Device"  column create\_time format a20 heading "Create Time"  ======================================================================  SQL> **select snap\_name, fs\_name, vol\_device,**  **to\_char(create\_time, 'DD-MON-YYYY HH24:MI:SS') as create\_time**  **from v$asm\_acfssnapshots**  **order by snap\_name;**  Snapshot Name File System Volume Device Create Time  --------------- --------------- ------------------------- --------------------  snap1 /documents3 /dev/asm/docsvol3-300 27-NOV-2010 16:11:29 |
|  |

### Delete Oracle ACFS Snapshot

Use the 'acfsutil snap delete' command to delete an existing Oracle ACFS snapshot:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/acfsutil snap delete snap1 /documents3**  acfsutil snap delete: Snapshot operation is complete. |

## Oracle ACFS and Dismount or Shutdown Operations

If you take anything away from this article, know and understand the importance of dismounting any active file system configured with an Oracle ASM Dynamic Volume Manager (ADVM) volume device, BEFORE shutting down an Oracle ASM instance or dismounting a disk group! Failure to do so will result in I/O failures and very angry users!

After the file system(s) have been dismounted, all open references to Oracle ASM files are removed and associated disk groups can then be dismounted or the Oracle ASM instance shut down.

If the Oracle ASM instance or disk group is forcibly shut down or fails while an associated Oracle ACFS is active, the file system is placed into an offline error state. When the file system is placed in an offline error state, applications will start to encounter I/O failures and any Oracle ACFS user data and metadata being written at the time of the termination may not be flushed to ASM storage before it is fenced. If a SHUTDOWN ABORT operation on the Oracle ASM instance is required and you are not able to dismount the file system, issue two sync command to flush any cached file system data and metadata to persistent storage:

|  |
| --- |
| [root@racnode1 ~]# **sync**  [root@racnode1 ~]# **sync** |

Using a two-node Oracle RAC, I forced an Oracle ASM instance shutdown on node 1 to simulate a failure:

|  |  |  |
| --- | --- | --- |
| |  |  | | --- | --- | | http://www.idevelopment.info/images/popup_dialog_stop_mark.gif | This should go without saying, but I'll say it anyway. DO NOT attempt the following on a production environment. | |
| SQL> **shutdown abort**  ASM instance shutdown | | |

Any subsequent attempt to access an offline file system on that node will result in an I/O error:

|  |
| --- |
| [oracle@racnode1 ~]$ **ls -l /documents3**  ls: /documents3: Input/output error  [oracle@racnode1 ~]$ df -k  Filesystem 1K-blocks Used Available Use% Mounted on  /dev/mapper/VolGroup00-LogVol00  145344992 22459396 115383364 17% /  /dev/sdb1 151351424 192072 143346948 1% /local  /dev/sda1 101086 12632 83235 14% /boot  tmpfs 2019256 0 2019256 0% /dev/shm  df: `/documents1': Input/output error  df: `/documents2': Input/output error  df: `/documents3': Input/output error  domo:PUBLIC 4799457152 1901758592 2897698560 40% /domo |

Recovering a file system from an offline error state requires dismounting and remounting the Oracle ACFS file system. Dismounting an active file system, even one that is offline, requires stopping all applications using the file system, including any shell references. For example, I had a shell session that previously changed directory (cd) into the /documents3 file system before the forced shutdown:

|  |
| --- |
| [root@racnode1 ~]# **umount /documents1**  [root@racnode1 ~]# **umount /documents2**  [root@racnode1 ~]# **umount /documents3**  umount: /documents3: device is busy  umount: /documents3: device is busy |

Use the Linux fuser or lsof command to identify processes and kill if necessary:

|  |
| --- |
| [root@racnode1 ~]# **fuser /documents3**  /documents3: 16263c  [root@racnode1 ~]# **kill -9 16263**  [root@racnode1 ~]# **umount /documents3** |

Restart the Oracle ASM instance (or in my case, all Oracle Grid Infrastructure services were stopped as a result of me terminating the Oracle ASM instance):

|  |
| --- |
| [root@racnode1 ~]# **/u01/app/11.2.0/grid/bin/crsctl stop cluster**  [root@racnode1 ~]# **/u01/app/11.2.0/grid/bin/crsctl start cluster** |

All of my Oracle ACFS volumes were added to the Oracle ACFS mount registry and will therefore automatically mount when Oracle Grid Infrastructure starts. If you need to manually mount the file system, verify the volume is enabled before attempting to mount:

|  |
| --- |
| [root@racnode1 ~]# **mount**  /dev/mapper/VolGroup00-LogVol00 on / type ext3 (rw)  proc on /proc type proc (rw)  sysfs on /sys type sysfs (rw)  devpts on /dev/pts type devpts (rw,gid=5,mode=620)  /dev/sdb1 on /local type ext3 (rw)  /dev/sda1 on /boot type ext3 (rw)  tmpfs on /dev/shm type tmpfs (rw)  none on /proc/sys/fs/binfmt\_misc type binfmt\_misc (rw)  sunrpc on /var/lib/nfs/rpc\_pipefs type rpc\_pipefs (rw)  oracleasmfs on /dev/oracleasm type oracleasmfs (rw)  domo:PUBLIC on /domo type nfs (rw,addr=192.168.1.121)  /dev/asm/docsvol1-300 on /documents1 type acfs (rw)  /dev/asm/docsvol2-300 on /documents2 type acfs (rw)  /dev/asm/docsvol3-300 on /documents3 type acfs (rw) |

## Resize File System

With Oracle ACFS, as long as there exists free space within the ASM disk group, any of the ASM volumes can be dynamically expanded which means the file system gets expanded as a result. Note that if you are using another file system other than Oracle ACFS, as long as that file system can support online resizing, they too can be dynamically re-sized. The one exception to 3rd party file systems is online shrinking. Ext3, for example, supports online resizing but does not support online shrinking.

Use the following syntax to add space to an Oracle ACFS on the fly without the need to take any type of outage.

First, verify there is enough space in the current Oracle ASM disk group to extend the volume:

|  |
| --- |
| SQL> **select name, total\_mb, free\_mb, round((free\_mb/total\_mb)\*100,2) pct\_free**  2 **from v$asm\_diskgroup**  3 **where total\_mb != 0**  4 **order by name;**  Disk Group Total (MB) Free (MB) % Free  --------------- ------------ ------------ -------  CRS 2,205 1,809 82.04  DOCSDG1 98,303 12,187 12.40  FRA 33,887 22,795 67.27  RACDB\_DATA 33,887 30,584 90.25 |

|  |  |  |
| --- | --- | --- |
| |  |  | | --- | --- | | http://www.idevelopment.info/images/popup_dialog_information_mark.gif | The same task can be accomplished using the ASMCMD command-line utility:  [grid@racnode1 ~]$ **asmcmd lsdg** | |

From the 12GB of free space in the DOCSDG1 ASM disk group, let's extend the file system (volume) by another 5GB. Note that this can be performed while the file system is online and accessible by clients — no outage is required:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/acfsutil size +5G /documents3**  acfsutil size: new file system size: 26843545600 (25600MB) |

Verify the new size of the file system from all Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **df -k**  Filesystem 1K-blocks Used Available Use% Mounted on  /dev/mapper/VolGroup00-LogVol00  145344992 21952712 115890048 16% /  /dev/sdb1 151351424 192072 143346948 1% /local  /dev/sda1 101086 12632 83235 14% /boot  tmpfs 2019256 1135852 883404 57% /dev/shm  domo:PUBLIC 4799457152 1901103872 2898353280 40% /domo  /dev/asm/docsvol1-300  33554432 197668 33356764 1% /documents1  /dev/asm/docsvol2-300  33554432 197668 33356764 1% /documents2  /dev/asm/docsvol3-300  26214400 183108 26031292 1% /documents3  [root@racnode2 ~]# **df -k**  Filesystem 1K-blocks Used Available Use% Mounted on  /dev/mapper/VolGroup00-LogVol00  145344992 13803084 124039676 11% /  /dev/sdb1 151351424 192072 143346948 1% /local  /dev/sda1 101086 12632 83235 14% /boot  tmpfs 2019256 1135852 883404 57% /dev/shm  domo:Public 4799457152 1901103872 2898353280 40% /domo  /dev/asm/docsvol1-300  33554432 197668 33356764 1% /documents1  /dev/asm/docsvol2-300  33554432 197668 33356764 1% /documents2  /dev/asm/docsvol3-300  26214400 183108 26031292 1% /documents3 |

## Use fsck to Check and Repair the Cluster File System

Use the regular Linux fsck command to check and repair the Oracle ACFS. This only needs to be performed from one of the Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/fsck -t acfs /dev/asm/docsvol3-300**  fsck 1.39 (29-May-2006)  fsck.acfs: version = 11.2.0.1.0.0  fsck.acfs: ACFS-00511: /dev/asm/docsvol3-300 is mounted on at least one node of the cluster.  fsck.acfs: ACFS-07656: Unable to continue |

The fsck operating cannot be performed while the file system is online. Unmount the cluster file system from all Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **umount /documents3**  [root@racnode2 ~]# **umount /documents3** |

Now check the cluster file system with the file system unmounted:

|  |
| --- |
| [root@racnode1 ~]# **/sbin/fsck -t acfs /dev/asm/docsvol3-300**  fsck 1.39 (29-May-2006)  fsck.acfs: version = 11.2.0.1.0.0  Oracle ASM Cluster File System (ACFS) On-Disk Structure Version: 39.0  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  \*\*\*\*\*\*\*\*\*\* Pass 1: \*\*\*\*\*\*\*\*\*\*  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  The ACFS volume was created at Fri Nov 26 17:20:27 2010  Checking primary file system...  Files checked in primary file system: 100%  Checking if any files are orphaned...  0 orphans found  fsck.acfs: Checker completed with no errors. |

Remount the cluster file system on all Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **/bin/mount -t acfs /dev/asm/docsvol3-300 /documents3**  [root@racnode2 ~]# **/bin/mount -t acfs /dev/asm/docsvol3-300 /documents3** |

## Drop ACFS / ASM Volume

Unmount the cluster file system from all Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **umount /documents3**  [root@racnode2 ~]# **umount /documents3** |

Log in to the ASM instance and drop the ASM dynamic volume from one of the Oracle RAC nodes:

|  |
| --- |
| [grid@racnode1 ~]$ **sqlplus / as sysasm**  SQL> **ALTER DISKGROUP docsdg1 DROP VOLUME docsvol3;**  Diskgroup altered. |

|  |  |  |
| --- | --- | --- |
| |  |  | | --- | --- | | http://www.idevelopment.info/images/popup_dialog_information_mark.gif | The same task can be accomplished using the ASMCMD command-line utility:  [grid@racnode1 ~]$ **asmcmd voldelete -G docsdg1 docsvol3** | |

Unregister the volume and mount point from the Oracle ACFS mount registry from one of the Oracle RAC nodes:

|  |
| --- |
| [root@racnode1 ~]# **acfsutil registry -d /documents3**  acfsutil registry: successfully removed ACFS mount point /documents3 from Oracle Registry |

Finally, remove the mount point directory from all Oracle RAC nodes (if necessary):

|  |
| --- |
| [root@racnode1 ~]# **rmdir /documents3**  [root@racnode2 ~]# **rmdir /documents3** |