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Oracle ACFS 23ai

Technical Overview

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Purpose statement

This document provides an overview of features and enhancements included in release 23ai. It is intended solely to help you assess the business benefits of upgrading to 23ai and planning for the implementation and upgrade of the product features described.

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Table of contents

Introduction

Cloud. The present and future move towards a Cloud world. Companies that design, plan, and correctly implement their business around a Cloud-centric architecture will thrive and succeed. The Cloud world considers several components; none is more critical than the foundations, which have the storage layer as a vital component. This storage layer must possess a wide array of features that suit this Cloud-bound destination.

Oracle Advanced Cluster File System (from now on, Oracle ACFS) offers all these and more. By fulfilling all industry standards and complying with POSIX and X/OPEN, Oracle ACFS supports multiple operating systems such as Oracle Linux, Redhat, Novell SLES, Solaris, and AIX. Oracle ACFS supports various server platforms, ranging from traditional server environments to Oracle Engineered Systems such as the Oracle Exadata Database Machine and the Oracle Database Appliance. Has become the storage foundation of choice for diverse Cloud offerings.

Oracle ACFS has broadened its scope as a cluster file system throughout years of constant growth and evolution, incorporating various features and functionality into its offering and becoming the preferred storage management solution of choice for application files and Oracle Database files. Oracle ACFS allows for file-based and filesystem-based snapshots, providing its users with the capability of provisioning test and development environments simply and efficiently. Tagging and encryption also offer a framework for flexible and secure storage management operations.

Customers can leverage Oracle ACFS replication capabilities to have a disaster recovery site for their application data or provisioning test and development environments in a different cluster. Furthermore, Oracle ACFS provides customers with comprehensive features such as highly available NFS and SMB services, automatic resizing, support for sparse files, metadata acceleration, file system freezing, and more.

Oracle ACFS, through its comprehensive arrangement of features and functionality, provides scalable, high-performance, and highly available solutions that simplify system and storage management and lays the foundation for your Cloud architecture.

What is Oracle ACFS

Architecture

Oracle ACFS, as part of Oracle Grid Infrastructure, is integrated with Oracle ASM, Oracle ADVM, and Oracle Clusterware, as shown in diagram 1 below. ACFS communicates with Oracle ASM to obtain ASM disk group storage addresses and uses these addresses to read and write ACFS data directly onto ASM storage for maximum performance. It also communicates with Oracle Clusterware to facilitate resource management for ACFS.
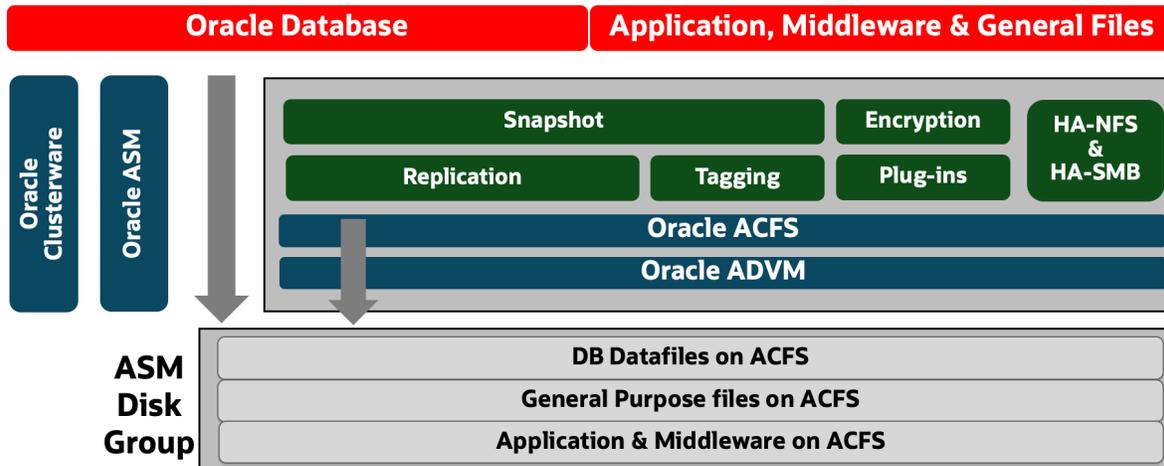

Diagram 1 – Oracle ACFS Architecture

Upon creating an Oracle ADVM volume, ACFS builds a block device special file, which provides ACFS with a standard device interface for direct access to disk group devices. As shown in the diagram, all ACFS I/O requests are transferred directly to ASM disk group storage. ACFS IO does not pass through the Oracle ASM instance.

ASM integration allows ACFS to participate in ASM storage management operations, including balanced distribution of ASM disk group file extents, dynamic file resizing, and online add/remove disk group storage devices. ACFS also benefits from ASM file extent striping and mirroring for performance and highly available storage access.

Likewise, in an Oracle Exadata equipped with Exascale technology, ACFS is integrated with Oracle Exascale Vaults, Oracle Exascale Snapshots, and the rest of the Exascale software stack, as well as the traditional GI and Oracle Clusterware, as shown in diagram 1 above. ACFS communicates with Oracle Exascale Services to obtain vault storage addresses and uses these addresses to read and write ACFS over a low latency IO path into Oracle Cell storage for maximum performance. It also communicates with Oracle Clusterware to facilitate resource management for ACFS.

Grid Infrastructure integration allows Oracle ACFS to leverage Clusterware resources like cluster membership state transitions, driver loading, automatic file system mounts and unmounts, and volume enabling and disabling; all these provide High Availability for both Oracle ACFS and Oracle ADVM resources.

Oracle ACFS is a complete storage solution that eliminates the need for expensive third-party solutions, bringing together high availability and best-in-class features to manage customers' storage needs. Oracle ACFS offers a robust cluster file system with the best performance, simplicity in its management, and high availability as part of the Grid Infrastructure stack. Also, as part of its offering, the following features stand out:

- Encryption:
    - Encryption in ACFS allows for data-at-rest protection, which encrypts filesystem data using file and volume-level keys. Oracle ACFS encryption supports highly secure key life cycle management options such as Oracle

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Key Vault and Oracle Cluster Registry for key store purposes.

- Snapshots:

  - Oracle ACFS can generate sparse, point-in-time read-write or read-only copies of Oracle ACFS File systems and single files. Snapshots provide an efficient tool for test and development environment provisioning, database testing, file system backups, pluggable database snapshot copies, and customized VM images. Oracle ACFS snapshots are versatile in their management via the Oracle ACFS command line *acfsutil* or the standard Linux *reflink* command line. Starting in 21c, Oracle ACFS introduces file-based snapshots, allowing customers to create snapshots of individual files in Linux-based Oracle ACFS file systems.

- Replication:

  - Oracle ACFS provides the capability to replicate an entire file system to a different location so that customers can offer filesystems for testing, development, and disaster recovery. Since 12c release 2, Oracle ACFS replication evolved into a snapshot-based replication solution, enhancing its existing capabilities and providing maximum efficiency and flexibility in its replication method. Starting in 18c, Oracle ACFS introduces role reversal, allowing a standby site to become an active site and the active site to become a standby site if this is required. Starting in 21c, Oracle ACFS introduces replication failover. Starting in 23ai, ACFS introduces significant replication enhancements like SSL-based transport, cross-version replication, coordinated failover, and an SSH key setup assistant.

- NAS Maximum Availability eXtensions

  - Customers can leverage Oracle ACFS to present ACFS file systems to remote clients using network protocols such as NFS or SMB without requiring additional infrastructure. Oracle ACFS NAS Max eXtensions allow the above protocols to run in high availability mode in an Oracle RAC Cluster.

What's new in Oracle ACFS 23ai

Oracle ACFS is a mature cluster file system that has evolved constantly since its inception as part of the Oracle Grid Infrastructure stack. In release 23ai, Oracle ACFS offers the following new features:

ACFS Auto Resize Variable Threshold
ACFS auto resize now allows you to configure the threshold percentage for your file system's automatic resize. This allows you to benefit from a more flexible threshold. Previously, the threshold was fixed at 10%. Now, you can customize it to your specific use case needs.

ACFS Replication Enhancements
- ACFS replication now allows primary clusters to replicate to standby clusters on a previous or older release. This feature provides flexibility in replication configurations, providing ample time for upgrading and lifecycle maintenance.
- New commands, `acfsutil repl switchover`, and `acfsutil repl failover` offer support for coordinated and unplanned failovers. This provides flexibility for replication configurations, role switches, and failover management.
- A new Secure Sockets Layer (SSL) transport has been introduced for communication between primary and standby ACFS replication sites. This new transport is optional and only supported on OL8/X64 platforms, where you can choose to leverage it or continue using ssh-based replication.
- Finally, an SSH key setup assistant, acfsreplssh, has been introduced to help you configure, verify, or delete the host and user keys required when SSH-based replication is used.

ACFS Encryption Enhancements
- ACFS Encryption allows you to migrate from Oracle Cluster Registry to Oracle Key Vault. This provides a centralized point for industry-standard key lifecycle management using Oracle Key Vault.
- ACFS Encryption can now be optionally configured to use the OCI Vault Key Management System. ACFS file systems Volume Encryption Keys on OCI can now be encrypted using OCI Vault Master Encryption keys, adding an extra level to the key hierarchy and introducing key lifecycle management capabilities within Oracle Cloud Infrastructure.

ACFS Snapshots Enhancements
You can now backup and restore PDB snapshot copies on ACFS. This provides space-efficient storage unique to ACFS snapshots.

In addition, ACFS snapshot functionality is integrated with Oracle Exascale snapshot functionality and can be used to snapshot individual files, entire file systems, or whole volumes.

ACFS Sparse Backup and Restore of Snapshots
The `acfsutil snap duplicate` command can now generate a backup of entire ACFS file systems and their snapshots while preserving its sparseness. You can now apply a full backup to another location while retaining the original sparseness. You can now replicate an entire ACFS file system and its snapshot tree.

Pluggable Database (PDB) Snapshot Carousel Support
Oracle ACFS now supports PDB Snapshot Carousel, which allows you to maintain a library of PDB Snapshots. Oracle Database files stored on Oracle ACFS file systems can now leverage PDB Snapshot Carousel with ACFS snapshot technology.

Large Volume Support

Oracle ADVM now supports volumes of up to 1 Petabyte with Oracle ASM. A new disk group attribute that allows ADVM extent sizes to be increased to 64 Mb provides the base for this new limit for newly created ADVM volumes. With Oracle Exascale, Oracle ACFS now supports file systems of up to 32 Petabytes.
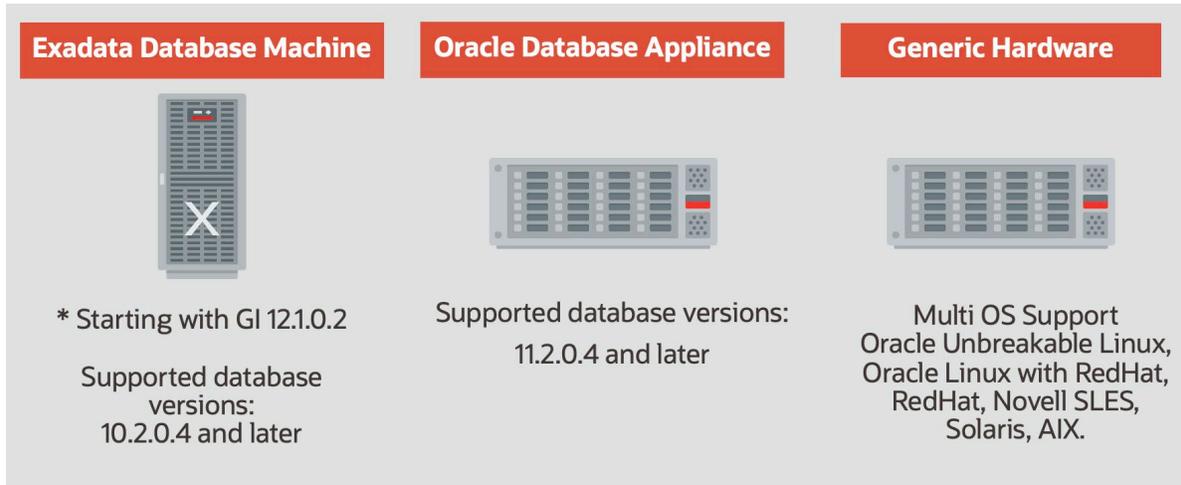
Oracle ACFS Platform Support

Exadata Database Machine	Oracle Database Appliance	Generic Hardware
* Starting with GI 12.1.0.2 Supported database versions: 10.2.0.4 and later	Supported database versions: 11.2.0.4 and later	Multi OS Support Oracle Unbreakable Linux, Oracle Linux with RedHat, RedHat, Novell SLES, Solaris, AIX.

Diagram 2 – Oracle ACFS Platform Support for Exadata On-Premises, Oracle Database Appliance and Generic Hardware

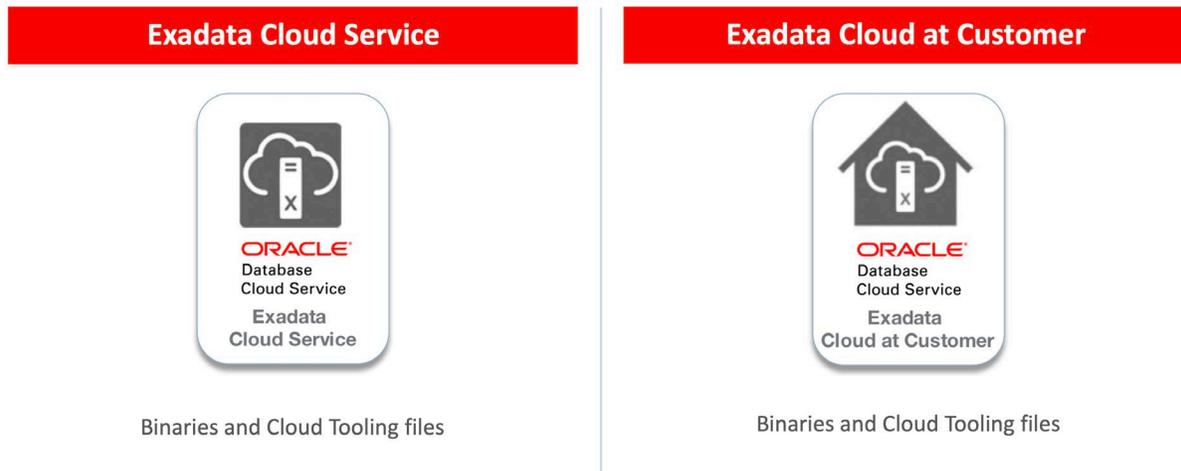| Exadata Cloud Service	Exadata Cloud at Customer
Binaries and Cloud Tooling files	Binaries and Cloud Tooling files

Diagram 3 – Oracle ACFS Platform Support for Exadata Cloud Service and Exadata Cloud at Customer

Oracle ACFS supports two major operating systems: Linux (Oracle Linux 8 and later, RedHat Enterprise Linux 8, Novell SLES 15) and AIX. For further information regarding kernel and Operating System specifics, refer to My Oracle Support note 1369107.1[1]. Oracle Engineered Systems with Oracle ACFS support include Oracle Database Appliance (ODA) and Oracle Exadata Database Machine.

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[1] https://support.oracle.com/epmos/faces/DocContentDisplay?id=1369107.1

Oracle ACFS on Oracle Database Appliance

Oracle ACFS is the primary cluster file system that stores database files and general-purpose data in the Oracle Database Appliance. It sits on top of Oracle ASM, enabling the Appliance to leverage the best of both products.

Oracle Database Appliance's adoption of Oracle ACFS provides many functionalities that require no additional effort or management.

File system management in the Oracle Database Appliance is done automatically by the integrated Appliance Manager, which means that all storage, including ACFS file systems and their underlying ASM disk groups, requires no administration. By default, the Oracle Database Appliance has three filesystems. These file systems are created in the already existing Oracle ASM disk groups, DATA, RECO, and REDO. Oracle Database Appliances leverage Oracle ACFS snapshot capabilities, allowing for fast and storage-efficient provisioning of test and development environments and performance equivalent to Oracle ASM.

Oracle ACFS on Exadata Database Machine

Oracle Exadata Database Machines run Oracle Linux and support Oracle ACFS for all database files and general-purpose files starting with Oracle ACFS 12c Release 1 (12.1.0.2). Oracle ACFS supports Exadata Hybrid Columnar Compression features natively, although Oracle ACFS does not support Oracle Smart Scan (predicate processing) and cannot push database operations directly to the Exadata cell storage; thus, the recommendation for storing database files on Oracle Exadata is to use Oracle ASM. Nevertheless, countless Exadata customers host their database files on ACFS due to ACFS's exceptional snapshot capabilities and test/dev lifecycle management.

With the 24.1 release of Exadata, Oracle ACFS will also integrate natively with all Oracle Exascale functionality, including volume snapshots, clones, and Exascale Block Volumes. Management of Oracle ACFS can be done through the command line or REST APIs native to Oracle Exascale software. Additionally, the maximum volume size with Oracle Exascale Direct Volumes is 32 petabytes.

Oracle ACFS and GoldenGate

Oracle Maximum Availability Architecture best practices include leveraging ACFS as part of GoldenGate's diverse set of operations. Among the different use cases, GoldenGate is a compelling solution for database migration, active-active database replication, heterogeneous replication, middleware integration, etc. Oracle ACFS is recommended as a storage solution for GoldenGate trail files.

Oracle ACFS Use Cases

Customers use Oracle ACFS in multiple scenarios that can leverage and benefit from ACFS features and functionality. Oracle ACFS is ideal for Oracle RAC cluster environments, standalone deployments, Oracle middleware, Oracle Application environments, and other vendor-provided settings. Oracle ACFS use cases include managing Oracle Database files, general-purpose files, shared database homes, administrative files, log files, trace, and audit files, and storing Oracle GoldenGate trace and trail files. Oracle ACFS can also store and manage business and unstructured data, deliver NFS/SMB exported file systems, and leverage NFS/SMB to off-host backups. Oracle ACFS snapshot-based Replication complements Oracle Data Guard for Disaster Recovery solutions. Customers can also leverage Oracle ACFS Snapshots for quick provisioning test and development environments. Oracle ACFS is also the preferred solution for database migration data storage. Customers who use zero downtime migration can temporarily leverage ACFS's HA-NFS extensions to store data pump dump files and database backups. Finally, Oracle ACFS provides an ideal RMAN backup location, allowing for highly available, highly scalable, and highly performant storage without requiring additional database licenses. As a bonus, Oracle ACFS is already pre-configured and available in many of

Oracle's engineered systems. Please see below for a detailed list of Oracle ACFS use cases present among our extensive list of customers:
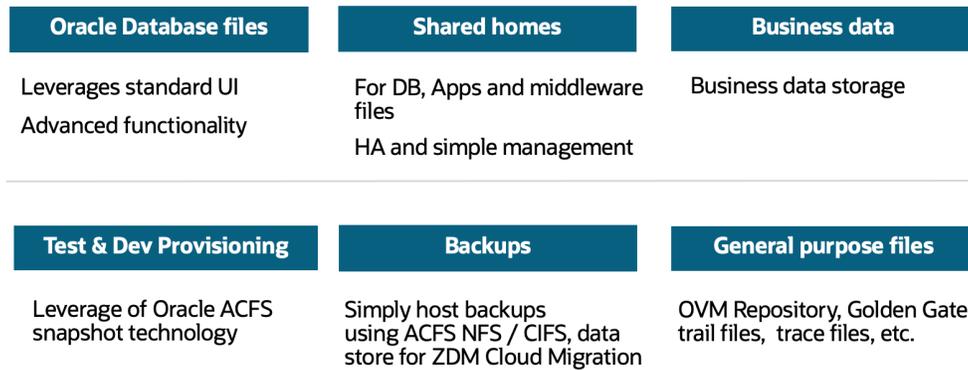
Oracle Database files	Shared homes	Business data
Leverages standard UI Advanced functionality	For DB, Apps and middleware files HA and simple management	Business data storage

Test & Dev Provisioning	Backups	General purpose files
Leverage of Oracle ACFS snapshot technology	Simply host backups using ACFS NFS / CIFS, data store for ZDM Cloud Migration	OVM Repository, Golden Gate trail files, trace files, etc.

Diagram 4 – Oracle ACFS Use Cases

Oracle ACFS Performance

Oracle ACFS delivers optimal performance for general-purpose files and Oracle Database files. For Database Performance, Oracle ACFS utilizes a direct I/O path from the database to the ASM disk group devices, bypassing the traditional OS VM page caching mechanism for file system applications. This model enables ACFS-based databases to achieve performance comparable to those configured with Oracle ASM. Comprehensive internal benchmarks using OLTP and DSS workloads have proven the performance of Oracle ACFS and Oracle ASM to be similar. For further information, please visit the Oracle ACFS web page.[2]

How to use Oracle ACFS

In non-Exascale mode, the Oracle Grid Infrastructure installation process includes the Oracle ASM, ACFS, and ADVM products. In Exascale mode, the Oracle Grid Infrastructure installation process includes Oracle ACFS to utilize the Exascale provided volumes. Once installed, it is easy to take advantage of all the features and functionalities that Oracle ACFS brings. Users only need to open the Oracle ASM Configuration assistant, which is under the grid user and commonly invoked via the command asmca, and then execute the following three steps. An Oracle ACFS file system will be created and mounted on all cluster nodes and ready for use.

1. Select the "Volumes" tab and create a Volume indicating relevant volume information. (Only available in non-Exascale mode.)

2. Select the "ASM Cluster File Systems" tab and create a file system indicating relevant file system information such as mount point, size, etc.

3. Run the requested scripts as root.

Oracle ACFS filesystems are ready and available throughout all cluster nodes upon mounting and creation. Filesystems will support Oracle Database data files, trace files, alert logs, application files, video, audio, text images, general-purpose application file data, etc. The following section will cover how to use Oracle ACFS based on its most relevant features and functionalities.

Oracle ACFS Encryption

Oracle ACFS offers encryption for its data. ACFS allows for the encryption of entire file systems, directories, or individual files. Encrypted and non-encrypted files can be present in the same file system. As shown below, the process is straightforward for users to leverage the functionality of this feature:

`acfsutil encr init` command allows for encryption to be initialized on any Oracle ACFS file system; it must be run before any use case, regardless of the key store in use. This command creates storage for the encryption keys. Customers can run it with the `-p` option, allowing the keys storage to be password-protected.

`acfsutil set encr -a -k -e -u -m` command configures encryption parameters for customers' Oracle ACFS file system, allowing for the initial set of changes of this parameter if required. The command sets the encryption parameters on execution, generates a volume encryption key, and stores them in the storage created in the init step. The options to be set are:

- `-a`, which allows for the encryption algorithm to be set; currently, AES is the only supported algorithm; however, when the `-k` option is set, `-a` AES must be specified.

- `-k` option that specifies the encryption key length; available options are 128, 192, and 256 (default).

- `-e`, if used, indicates that Oracle Key Vault will be used as the key store.

- `-u` reverses encryption from an Oracle ACFS file system by decrypting all encrypted files.

- `-m` option for specifying the mount point of the file system.

`acfsutil encr on -m -a -k -r` path command allows for encryption on an entire file system or given directory or file. For operations with this command, the user must have root privileges to encrypt an entire file system. All options are the same as the previous commands except for –r & path. The –r option allows encryption to be executed recursively for all existing contents under a specified directory. The path option specifies which directories will be encrypted.

Essential elements to be considered when using Oracle ACFS Encryption:

- Oracle ACFS can be used to store Oracle Database files. However, ACFS Encryption is not supported for database files; in this case, users must use the Oracle Database Advanced Security option.

- Oracle ACFS can use the Oracle Cluster Registry (OCR) as a key store. In this case, it is recommended that the Oracle Cluster Registry be backed up upon creation of the encryption key to ensure the availability of encryption keys from the backup.

- Oracle ACFS encrypted file copies will not be encrypted; encryption is only guaranteed if the copy occurs in an already encrypted directory.

- Starting in release 21c, Oracle ACFS supports encryption of individual files with no file size limit.

- Oracle ASM disk group compatibility attributes must be set in a particular fashion in certain use cases. Please review the Oracle ACFS Administrator's Guide for further guidance.[3]

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[3] https://docs.oracle.com/en/database/oracle/oracle-database/23/acfsg/

Oracle ACFS Snapshots

Oracle ACFS snapshot functionality can generate sparse, point-in-time read-write, or read-only copies of Oracle ACFS file systems or single files. It uses space-efficient copy-on-write functionality. Oracle ACFS allocates file extent value updates in new storage while snapshots maintain pointers to existing extent values, keeping a point-in-time view of the file system.

In addition to integrating with Oracle Exascale full-volume snapshots, Oracle ACFS stores Snapshots within the originating ACFS file system. If additional storage for files and snapshots is needed, Oracle ACFS allows for dynamic file system resizing. Oracle ACFS snapshots are ready and available for use upon creation as long as the file system is mounted. Oracle ACFS can host up to 1023 full file system snapshots in a corresponding Oracle ACFS file system. Oracle ACFS supports creating snapshots of existing snapshots, providing full inheritance at any given point in the hierarchy, and tools to quickly show relationships and manage snapshots.

Oracle ACFS 18c introduced snapshot links with one command; this allows for a link to be created that offers access to snapshot contents via the link name path, hence providing easier snapshot management. As shown below, the process is straightforward for users to leverage the functionality of Oracle ACFS Snapshot capabilities. Additional snapshot commands are explained below:

`acfsutil snap create -r -w -p parent_snapshot snap_shot mount_point` command creates a snapshot following the user-specified options, which are:

- `[-r|-w]` snapshots are by default read-only; if the –w option is selected, the snapshot will be read-write. A snapshot can be later converted from read-write to read-only or vice versa with the `acfsutil snap convert` command.

- `snap_shot` indicates the snapshot name. A snapshot name can be changed via the `acfsutil snap rename` operation.

- `-p parent_snap_shot` When performing a snapshot of a snapshot, the parent snapshot named must be specified via this option.

- `mount_point`. This option specifies the file system mount point.

- A quota for a snapshot can be established through the `acfsutil snap quota` command.

`acfsutil snap info -t snap_shot mount_point` command provides information regarding a specific snapshot (specified by `snap_shot`) on the file system mounted on the specified mount point (`mount_point`). Option `-t` indicates that the output should contain a tree structure of the snapshot.

`acfsutil snap delete snap_shot mount_point` command deletes the specified snapshot (`snap_shot`) on the file system mounted on the specified mount point (`mount_point`).

For individual file snapshots, the following command utility is used:

`acfsutil fshare create source_file_path destination_file_path`

- `fshare` specifies that the snapshot to be created pertains to a single file.

- `source_file_path` specifies the file to be used as a source for the snapshot.

- `destination_file_path` specifies the path where the snapshot is to be created.

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Oracle ACFS introduced in 12c Release 2 the snap duplicate create and snap duplicate apply operations; this allows users to create a duplicate snapshot and a duplication stream to apply any changes in the original snapshot to the duplicate snapshot. Furthermore, users can create new Oracle ACFS file systems out of a snapshot and apply changes in the source snapshot to the newly created file system. Please review the Oracle ACFS Administrator's guide [3] for more information on snap duplicate create and apply operations.

Oracle ACFS, in conjunction with Oracle Multitenant, allows customers to leverage snapshots with pluggable database technology. Using copy-on-write technology, Oracle ACFS allows for creating snapshot clones of pluggable databases, further broadening the customer's choices for the provisioning of test and development environments. Customers can use the pluggable database clones to test new applications, run all their test scenarios, and more without jeopardizing production data. Databases stored on Oracle ACFS require just a few steps to leverage this functionality.

Oracle ACFS Snapshot-based Replication

Oracle ACFS provides maximum efficiency and flexibility in asynchronous replication for customers' file systems. Replication has constantly evolved from log-based replication for application files to the current snapshot-based replication solution that supports entire file systems and application files. Oracle ACFS Replication provides a solution for replicating an Oracle ACFS file system across the network from a primary to a standby site. Complemented with Oracle Data Guard or GoldenGate, Oracle ACFS snapshot-based Replication provides the customer with an end-to-end DR solution for all files.

Oracle ACFS Snapshot-based replication transfers the differences between consecutive snapshots from the primary file system to the standby file system using the simple SSH protocol. Due to changing security landscapes, for organizations that wish to control access to systems even more tightly, in release 23ai, ACFS offers an alternative SSL-based transport with easily configurable lifecycle management. During initial snapshot replication from the active to the standby file system, Oracle ACFS will continue replicating the changes in the successive snapshots. Oracle ACFS Snapshot-based replication carries a timestamp that can be queried to synchronize database transactions with ACFS file system data.

Diagram 5 – Oracle ACFS Snapshot-Based Replication

Oracle ACFS Replication on primary sites running AIX, Linux, or Solaris works with standby sites running on any mentioned operating systems. Oracle ACFS Replication allows for encryption to be enabled, thus securing the replicated standby file system with any policies in place in the primary file system.

Oracle ACFS 18c introduced role reversal replication, which allows the original primary and standby locations to switch roles. One command enables users to change the original primary location to become the new standby and the original standby location to become the new primary. For more information on Oracle ACFS snapshot-based replication, please review the Oracle ACFS replication technical brief [4] and the Oracle ACFS Administrator's Guide. [5]

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4 ACFS File System Snapshot-Based Replication: How to Setup Guide
  https://www.oracle.com/a/tech/docs/acfs-file-system-snapshot-based-replication.pdf
5 Oracle ACFS Administrator's Guide
https://docs.oracle.com/en/database/oracle/oracle-database/23/acfsg/

Oracle ACFS Automatic Resize and File System Reduce

Oracle ACFS 12c Release 2 introduced `acfsutil size`, which provides an option for automatic file system resizing. The command allows the user to specify how much a file system should grow if the available free space reaches a certain threshold. The user can set a filesystem threshold; automatic filesystem resizing will happen upon reaching it.

The acfsutil size command allows for a size reduction of the file system. Users can use the `-q` option to obtain an estimate on the required data to be moved, helping further calculate the time the command could take to complete. Oracle ACFS size operations also modify the respective Oracle ADVM volume where the file system is mounted. This ensures that the volume size matches the new specified filesystem size. Starting in Oracle ACFS 21c, file system auto shrink is introduced and managed with the acfsutil size command. For more information, please review the Oracle ACFS Administrator's Guide. [3]

Oracle ACFS File System Freeze

`acfsutil freeze` and `acfsutil thaw` commands allow for pausing and resuming activities in an Oracle ACFS filesystem. acfsutil freeze command pauses all activity on the filesystem across all nodes in the cluster; users can then perform certain snapshot operations. Users can execute the acfsutil thaw command, and activity on the file system across nodes will resume. Please see below a basic introduction to Oracle ACFS freeze and thaw commands:

`acfsutil freeze -f mount_point` pauses activity on the specified file system. Option `-f` requires all data to be flushed to disk before any operations pause.

`acfsutil thaw mount_point` command resumes activity on the specified file system.

Oracle ACFS File System Storage Info

`acfsutil info storage` command is introduced, providing users with platform-independent information related to storage. The available information comprises Oracle ASM disk group information gathered from filesystem information, snapshot information, and disk group views. The command provides a simple way to get the information above with a basic set of configurable options: unit of measurement, disk group(s) to be queried, and whether additional information must be displayed. For more details, please review the Oracle ACFS Administrator's Guide. [3]

Oracle ACFS File System Diagnostic Commands

The `acfsutil meta` command copies the metadata from the specified Oracle ACFS file system and generates a file with all the collected information. This command simplifies the metadata collection process for file system diagnostics and support. This command's diagnostic and support nature presents a comprehensive list of options to determine its operation mode. Please review the Oracle ACFS Administrator's Guide for further and more detailed information. [3]

Oracle ACFS NAS Maximum Availability eXtensions (MAX)

Oracle ACFS Maximum Availability eXtensions enable NFS or SMB server execution in High Availability mode. This means that as long as one cluster node is available, the NFS or SMB exports will be available. Oracle ACFS NAS Maximum Availability eXtensions integrate with NAS protocols and the Oracle ACFS stack, providing ease of use without additional infrastructure.

The High Availability Network File Storage (HANFS) feature enables the configuration of highly available NFS servers using Oracle ACFS clusters, thus providing continuous NFS v2/v3/v4 exported paths. Customers can build the HANFS cluster configurations from their existing infrastructure or commodity servers and storage. Oracle ACFS now also supports HANFS NFS v4 with NFS Locks (limited to specific operating systems only – see the documentation for details[3]). Since Oracle 19c, HANFS has been certified as an RMAN NFS backup target in conjunction with ACFS and its robust availability and feature set.

Oracle ACFS NAS Maximum Availability eXtensions supports SMB services that communicate with Active Directory Domains and Microsoft servers. Samba or Microsoft SMB must be in place to ensure Oracle ACFS HA-SMB. Please refer to Oracle ACFS NAS Maximum Availability eXtensions technical brief 6 for further information.

Oracle ACFS NAS Maximum Availability extensions are the preferred storage solution for Oracle Zero Downtime Migration to Exadata On-Premises and Exadata Cloud@Customer. For more information, visit the *Logical Migration from On-Premises to Exadata Cloud@Customer or Exadata On-Premises using ACFS as a Backup Location* step-by-step guide.[6]

Conclusion

Oracle Advanced Cluster File System offers a complete, stable, and mature storage solution that has evolved to become the storage foundation for cloud architectures worldwide. Customers use Oracle ACFS in over 60 countries across all industries and many of the top S&P 500 companies.

Oracle ACFS offers evolved advanced functionality, as shown below. It provides best-in-class snapshot-based replication, tagging for group operations and encryption capabilities, file system resizing, remote services, network file system export extensions, and many more. Oracle ACFS provides a complete storage solution.

Diagram 6 – Oracle ACFS Features and Functionality

Oracle ACFS offers a universal way to manage customers' data, providing high availability, high performance, scalability, simplicity in its administration, data integrity, fast recovery, and savings in licensing costs.

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