Oracle Linux

Installing and Configuring Oracle ASMLIB v3

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Oracle Linux Installing and Configuring Oracle ASMLIB v3,

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Preface

Oracle Linux: Installing and Configuring Oracle ASMLIB v3 describes how to install and configure ASMLIB on Oracle Linux systems including Oracle Linux 8, and Oracle Linux 9.

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Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.

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the need to ensure continuity of service as Oracle's offerings and industry standards evolve. Because of these technical constraints, our effort to remove insensitive terms is ongoing and will take time and external cooperation.

1
About Oracle ASMLIB

Oracle ASMLIB is an optional support library for the Automatic Storage Management feature of the Oracle Database. Automatic Storage Management (ASM) simplifies database administration and reduces kernel resource usage, such as the number of open file descriptors. ASM eliminates the need for the DBA to directly manage many Oracle database files, requiring only the management of groups of disks allocated to the Oracle Database. ASMLIB can make an Oracle Database using ASM more efficient and capable of accessing the disk groups it's using.

Further technical information about Oracle ASMLIB can be found at the following resources:

- Database 23ai Installation Guide for Linux: Installing and Configuring Oracle ASMLIB Software

- Database 19c Installation Guide for Linux: Installing and Configuring Oracle ASMLIB Software

Release Notes for Oracle ASMLIB 3.1

ASMLIB is updated to version 3.1. The following notable changes are included:

- ASMLIB can use end-to-end data integrity protection when running on UEK R8 or later. This feature adds a layer of protection against data corruption by attaching integrity metadata to each I/O. The attached integrity metadata can be validated by I/O controller and storage device on write operations, and by ASM on read operations.

  End-to-end data integrity protection requires ASM disks to be placed on storage devices formatted with the T10 Protection Information, Type 1. Associated SCSI storage controllers must support DIX. NVMe storage controllers must support the separate metadata buffer feature.

- ASM can now select whether to use the logical or the physical block size on a per-I/O basis. This feature makes it possible for ASM to migrate or access disks that were originally configured using different block sizes. In earlier releases, the block size selection was global and applied to all disks on a system.

  To use per-I/O block size selection, the `ORACLEASM_USE_LOGICAL_BLOCK_SIZE` configuration option must be set to `false` and the Oracle Database must be patched to implement the per-I/O block size capability. See Known Issues.

- Unmap support is included, making it possible to reclaim unused disk space on thin-provisioned storage devices. This capability requires KABI_V3 (UEK R7 or later). Use `oracleasm querydisk -i` or `oracleasm discover -l` to query whether an ASM disk supports thin provisioning.

- When using KABI_V3 (UEK R7 or later) a universally unique identifier (UUID) is reported for those SCSI and NVMe storage devices that support it. Use `oracleasm querydisk -i` or `oracleasm discover -l` to get the UUID that uniquely identifies a storage device to ASM across all nodes in a cluster.

Release Notes for `oracleasm-support` 3.1

The following notable changes are included in `oracleasm-support` version 3.1:

- Disk labeling operations now inhibit writing ASM disks that are marked as being members of an ASM disk group. This is done to prevent inadvertently deleting or renaming ASM disks that are actively in use by other nodes in a cluster.

- Checks were added to the `oracleasm status` command to validate that the `oracleasm` service is fully operational. The checks include verifying that ASMLIB is installed and that the `io_uring` interface is accessible to the configured `ORACLEASM_UID`/`ORACLEASM_GID`.

- The `-i` option is added to the `oracleasm querydisk` command to print detailed information about the specified ASM disk.

  The `-l` option is added to the `oracleasm discover` command to print detailed information about all ASM disks attached to the system.

  The detailed information printed in each case includes device node, disk UUID, ASM disk group name, disk size, logical and physical block sizes, maximum I/O size, and whether the disk supports end-to-end data integrity and thin provisioning. Note that some information is only available when using KABI_V3 interface (UEK R7 or later).

Known Issues

- The following Oracle Database patches must be installed to support mounting and migration of disks created using different ASM block sizes:

  - Patch 37347369 - VOTING DISK CREATED WITH AFD ON 512E DISK IN PAST DOES NOT WORK WITH ASMLIB

  - Patch 37230154 - ASMCMD AFD_DECONFIGURE FAILS TO DELETE AFD RESOURCE

Release Notes for Oracle ASMLIB 3.0

Previous releases of Oracle ASMLIB supported several versions of interfaces implemented by the `oracleasm` driver over the years. The library picked the correct interface based on the `oracleasm` version reported by the kernel at runtime. Therefore, a single library binary could be used with various kernel releases.

Starting with ASMLIB version 3.0, another I/O submission interface is added to the library. The new I/O submission interface takes advantage of the high performance `io_uring` interface available in modern Linux kernels. If ASMLIB version 3.0 is loaded on a system that doesn't have an `oracleasm` driver loaded, is running a kernel that has `io_uring` enabled, and that supports a recent enough version of `io_uring`, the `io_uring` interface is used to submit I/O to the kernel instead of `oracleasm`.

The single ASMLIB version 3.0 binary handles all previous I/O submission interface versions in addition to `io_uring` and therefore no configuration changes are required when switching between kernels that don't have `io_uring` enabled and those that do.

The library automatically uses the appropriate interface for the running kernel.

Known Issues

- **Data integrity passthrough not supported with the `io_uring` interface.**

Data integrity passthrough isn't supported when using the `io_uring` interface, because of a kernel limitation. This issue might be resolved in a later kernel version.

Note that this limitation doesn't apply when running ASMLIB version 3.0 with the `oracleasm` driver on UEK R6.

- **ASMLIB version 3.0 for Arm is only supported with Oracle Database 19c**

Release Notes for `oracleasm-support` 3.0

The `oracleasm-support` package has been enhanced to work with version 3.0 of ASMLIB, which uses the generic `io_uring` interface to manage ASM disks on kernels that include this functionality. The updated `oracleasm-support` package continues to work with older kernels with backward compatibility. The command syntax remains the same irrespective of the kernel that's running.

On systems running UEK R7 or Oracle Linux 9 with RHCK, `oracleasm-support` automatically adds an I/O filter to protect ASM disks against accidental overwrites. The filter rejects any write operations that aren't started by ASM and prevents writes to ASM disks by admin commands such as `dd` after disks have been instantiated. No new user level commands are required to manage the I/O filter map. If a disk device is found to have a valid ASM disk label, a filter map entry is automatically added.

The `oracleasm` configuration has a new parameter `ORACLEASM_CONFIG_MAX_DISKS`, which specifies the maximum number of ASM disks that can be used in the system. This parameter is used to calculate the size of I/O filter map.

I/O filtering depends on BPF (Berkeley Packet Filter) functionality within the kernel.

Known Issues

- **`oracleasm-support-3.0.0-7` or later required for use with Oracle ASM Dynamic Volume Manager (Oracle ADVM)**

  You must install the `oracleasm-support-3.0.0-7` or later to use ASMLIB with Oracle ADVM on UEK R7 or later.

  `Patch 37405185 - ADD SUPPORT FOR ASMLIB V3 IN ADVM` is also required in the Oracle Clusterware home directory.

2
Installing and Upgrading Oracle ASMLIB

ASMLIB is a support library for the Automatic Storage Management (ASM) feature of the Oracle Database. Oracle provides a Linux-specific implementation of this library. This document describes how to download, install, and upgrade the ASM library on Oracle Linux.

What do you need?

- A system with any of the following installed:
  - Oracle Linux 8
  - Oracle Linux 9
- Root administrator privileges on the host Linux system.

> **✎ Note:**
>
> If the host system is using Oracle Linux 7, see Oracle Linux 7: Installing and Configuring Oracle ASMLIB.

Updating ULN Subscriptions or Downloading Packages

The `oracleasmlib` and `oracleasm-support` packages are available on the Unbreakable Linux Network (ULN). You can also manually download the packages.

We recommend installing from ULN to keep the system updated.

- Subscribe to ULN Channels.

  If you're using ULN, subscribe to the "Oracle ASMLIB" and "Oracle Linux Addons" ULN channels.

  1. Sign in to https://linux.oracle.com with your ULN username and password.
  2. On the Systems tab, from the list of registered systems, select the link name for the specified system.
  3. On the System Details page, select Manage Subscriptions.
  4. On the System Summary page, select the required "`Oracle ASMLIB`" and "`Oracle Linux Addons`" channels from the Available Channels list, then click the right-arrow (→) to move selected channels to the Subscribed Channels list.
  5. Click Save Subscriptions.

- Download packages manually.

  If you don't use ULN you can download the driver packages from the following resources, but you must keep them updated on the system when new patches are released:

  - On Enterprise Linux 9: https://www.oracle.com/linux/downloads/linux-asmlib-v9-downloads.html

    – On Enterprise Linux 8: https://www.oracle.com/linux/downloads/linux-asmlib-v8-downloads.html

Installing Required Packages

The following steps describe how install the ASM support tools, the ASM library, and the kernel driver (when applicable).

You must be subscribed to the ULN channels or have the packages downloaded before you proceed. See Updating ULN Subscriptions or Downloading Packages for more information.

1. Log into the system with an account that has administrator privileges.

2. Install the `oracleasm-support` and `oracleasmlib` packages.

    ```
    sudo dnf install oracleasm-support oracleasmlib
    ```

3. Install the kernel driver if required.

    a. On systems running UEK R7, no driver is required to use ASMLIB because `io_uring` is already enabled in the kernel. You can restrict `io_uring` to processes run by a particular group id. See Enabling or Restricting `io_uring` for more information.

    b. On systems running UEK R6 or earlier, the `oracleasm` kernel driver is already included and installed with the kernel.

    c. On Oracle Linux 8 systems using RHCK, you must install the `oracleasm` driver:

        ```
        sudo dnf install kmod-redhat-oracleasm
        ```

    d. On Oracle Linux 9 systems using RHCK, you don't need to install the kernel driver, but you must enable `io_uring` in the kernel. See Enabling or Restricting `io_uring`.

Enabling or Restricting `io_uring`

The `io_uring` interface is used instead of the `oracleasm` kernel driver, when the system is running UEK R7 or Oracle Linux 9 with RHCK. If the system is running Oracle Linux 9 with RHCK, you must either enable `io_uring` globally, or you can enable `io_uring` so that its restricted to processes that are run by a particular group. `io_uring` is globally enabled in UEK R7 by default, but you can edit the system configuration to restrict it to processes that are run by a particular group, if you prefer.

To edit the system configuration to enable or restrict `io_uring`, use the following procedure.

1. Edit `/etc/sysctl.conf` to update the kernel configuration.

    • You can fully enable `io_uring` in the kernel by adding the following line to `/etc/sysctl.conf`:

        ```
        kernel.io_uring_disabled = 0
        ```

    • Alternatively, you can restrict `io_uring` API access to Oracle Database processes by adding the following lines to `/etc/sysctl.conf`:

        ```
        kernel.io_uring_disabled = 1
        kernel.io_uring_group = <GID>
        ```

Set *<GID>* to the numeric ID of the group specified when configuring ASMLIB with the `oracleasm configure` command.

2. Reload the system configuration.

   If you have updated `/etc/sysctl.conf`, reload the system configuration by running:

   ```
   sudo sysctl -p
   ```

Upgrading ASMLIB

Update ASMLIB by using the `dnf update` command.

- Run the `dnf update` command to fully update the system.

  ```
  sudo dnf update -y
  ```

  We recommend that new ULN subscribers that have migrated from Red Hat update the `oracleasmlib` package from ULN.

3
Configuring Oracle ASMLIB

The following procedures are a guideline for the initial configuration of ASMLIB on Oracle Linux. See the following Oracle Database documentation for more information:

- Database 23ai Administering Oracle ASMLIB and Disks

- Database 19c Administering Oracle ASMLIB and Disks

> **❶ Important:**
>
> Changes to ASMLIB configuration don't take immediate effect. Stop the database and all related processes when reconfiguring ASMLIB. Changes usually take effect after the next system reboot.

Initializing ASMLIB Configuration

After installation, configure the ASMLIB software and scan for disks on boot by using the management utility, `/usr/sbin/oracleasm`.

You can read the ASMLIB configuration file at `/etc/sysconfig/oracleasm`, however we recommend that you always use `oracleasm configure` to change configuration parameters, so that this file is always correctly configured. The interactive (`-i`) option is typically used to configure the library for the first time.

- Run the configuration utility in interactive mode to initialize the configuration.

  ```
  sudo oracleasm configure -i
  ```

  If run for the first time, the `oracleasm configure` utility asks a series of questions, including which user id and group id to assign permission to use ASMLIB.

  If the Oracle Database is configured to run as the `oracle` user and the `dba` group, the output looks similar to the following:

  ```
  Configuring the Oracle ASM library driver.

  This will configure the on-boot properties of the Oracle ASM library
  driver.  The following questions will determine whether the driver is
  loaded on boot and what permissions it will have.  The current values
  will be shown in brackets ('[]').  Hitting <ENTER> without typing an
  answer will keep that current value.  Ctrl-C will abort.

  Default user to own the driver interface []: oracle
  Default group to own the driver interface []: dba
  Start Oracle ASM library driver on boot (y/n) [n]: y
  Scan for Oracle ASM disks on boot (y/n) [y]: y
  Maximum number of disks that may be used in ASM system [2048]: 2048
  ```

```
Enable iofilter if kernel supports it (y/n) [y]: y
Writing Oracle ASM library driver configuration: done
```

- Enable and start the `oracleasm` service.

  After you have finished configuring ASMLIB, enable and start the `oracleasm` service.

  ```
  sudo systemctl enable --now oracleasm
  ```

Configuring ASM I/O Filtering

`oracleasm-support` includes an ASM I/O filtering feature that depends on BPF infrastructure support in the kernel. This feature is available in UEK R7 or Oracle Linux 9 with RHCK. When enabled, the I/O filter feature rejects any write operations that aren't started by ASM and prevents writes to ASM disks by admin commands such as `dd` after disks have been added to the ASM system.

See Release Notes for `oracleasm-support` 3.0 for more information about the I/O filter feature.

1. Run the configuration utility to enable or disable I/O filtering.

   By default, the I/O filter feature is enabled. Use the `oracleasm configure` command to disable or enable the I/O filter feature.

   a. Disable the I/O filter.

      ```
      sudo oracleasm configure --iofilter n
      ```

   b. Enable the I/O filter.

      ```
      sudo oracleasm configure --iofilter y
      ```

2. Run the configuration utility to set the maximum number of disk devices that ASMLIB can use with I/O filtering.

   I/O filtering requires a mapping of the maximum number of disk devices that ASMLIB can use. The default value is 2048, but this value can be changed to any value, such as 4096, by running:

   ```
   sudo oracleasm configure --maxdevs 4096
   ```

Making Disks Available to ASMLIB

Every disk that the Oracle Database accesses using ASMLIB must be labeled. This topic describes how to create an ASM disk label, verify it, and how to remove a label.

The following commands show how to scan disks, and create ASM disk labels. Instructions are also provided for viewing and querying disk labels and also for removing them.

1. Use the `oracleasm scandisks` command to scan all block devices attached to the system for ASM disk labels and make any ASM disks found available to ASM.

   ```
   sudo oracleasm scandisks
   ```

Output might appear similar to the following:

```
Reloading disk partitions: done
Cleaning any stale ASM disks...
Setting up iofilter map for ASM disks: done
Scanning system for ASM disks...
```

2. Use the `oracleasm createdisk` command to label a disk.

```
sudo oracleasm createdisk VOL1 /dev/sdg1
```

The following output might be displayed:

```
Writing disk header: done
Instantiating disk: done
```

3. Use the `oracleasm listdisks` command to view existing disk labels.

```
sudo oracleasm listdisks
```

Output might appear similar to the following:

```
VOL1
VOL2
VOL3
```

4. Use the `oracleasm querydisk` command to check whether a disk device has a label.

```
sudo oracleasm querydisk /dev/sdg1
```

If the device isn't labeled as an ASM disk, the following output is displayed:

```
Device "/dev/sdg1" is not marked as an ASM disk
```

If the device is labeled as an ASM disk, output appears as follows:

```
Device "/dev/sdg1" is marked an ASM disk with the label "VOL1"
```

You can also query an ASM disk label to see whether the label is valid, for example:

```
sudo oracleasm querydisk VOL1
```

5. Use the `oracleasm deletedisk` command to remove an ASM label from a disk.

```
sudo oracleasm deletedisk VOL1
```

The following output might be displayed:

```
Clearing disk header: done
Dropping disk: done
```

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When you have finished configuring disk availability, you can check that the disks are visible in ASM. See Validating ASM Disk Visibility Using a Discovery String.

Checking ASMLIB Configuration Status

Use the `oracleasm status` command to show the status of ASMLIB configuration. This command can help identify issues and can show which features are enabled.

* Run `oracleasm status` to view the current configuration status.

```
sudo oracleasm status
```

The following example output is taken from a system running UEK R8:

```
Checking if the oracleasm kernel module is loaded: no (Not required with
kernel 6.12.0)
Checking if /dev/oracleasm is mounted: no (Not required with kernel 6.12.0)
Checking which I/O Interface is in use: io_uring (KABI_V3)
Checking if ASMLIB can be loaded: yes
Checking if io_uring is enabled: yes
Checking if io_uring is accessible to the configured DB user: yes
Checking if io_uring supports integrity passthrough: yes
Checking if ASM disks have the correct ownership and permissions: yes
Checking if ASM I/O filter is set up: yes
```

The following checks are performed:

– Check if the `oracleasm` kernel module is loaded: The kernel module is required for earlier kernels that don't include `io_uring`.

– Check if the `/dev/oracleasm` is mounted: When the `oracleasm` kernel module is used, a device node is configured and mounted. This action isn't required with kernels that include `io_uring`.

– Check which I/O interface is being used: in the case of a kernel that's using KABI_V3 the `io_uring` interface is used, while a kernel using KABI_V2 uses the `oracleasm driver` interface.

– Check that ASMLIB is installed and can be loaded.

Note that the following checks are only performed when KABI_V3 is detected:

– Check if `io_uring` is enabled: On a kernel that includes `io_uring`, the `io_uring` feature must be enabled to use ASMLIB. See Enabling or Restricting `io_uring`.

– Check that the `io_uring` is accessible to a process running with `ORACLEASM_UID`/`ORACLEASM_GID` credentials. See Enabling or Restricting `io_uring`.

– Check whether end-to-end data integrity support is available through the `io_uring` interface (UEK R8).

– Check if ASM disks have correct ownership and permissions: Checks that any disk devices that are labeled for ASM use are owned by the user and group configured for ASM, and set when you initialized the configuration. See Initializing ASMLIB Configuration.

–   Check if ASM I/O filter is enabled and configured: On kernels that include the required
    BPF functionality, I/O filtering can be enabled and configured to protect ASM disks
    from accidental overwrites. See Configuring ASM I/O Filtering.

Validating ASM Disk Visibility Using a Discovery String

ASM uses discovery strings to describe which of the labeled ASM disks attached to a system
are available to the Oracle Database instance.

Use the `oracleasm discover` command to validate ASM discovery strings and view
characteristics of the associated ASM disks.

*   List all ASM disks on the system.

    ```
    sudo oracleasm discover
    ```

    The following output might be displayed:

    ```
    Using ASMLib from /opt/oracle/extapi/64/asm/orcl/1/libasm.so
    [ASM Library - Linux, version 3.0.0 (KABI_V3), Aug 26 2024 00:20]
    Discovered disk: ORCL:DB1 [1044162 blocks (534610944 bytes), blksz
    512/512, maxio 524288 bytes, integrity none]
    Discovered disk: ORCL:DB2 [1044162 blocks (534610944 bytes), blksz
    512/512, maxio 524288 bytes, integrity none]
    Discovered disk: ORCL:VOL1 [1044162 blocks (534610944 bytes), blksz
    512/512, maxio 524288 bytes, integrity none]
    Discovered disk: ORCL:VOL2 [1044162 blocks (534610944 bytes), blksz
    512/512, maxio 524288 bytes, integrity none]
    ```

*   List all ASM disks whose labels begin with "VOL".

    ```
    sudo oracleasm discover ORCL:VOL\*
    ```

    The following output might be displayed:

    ```
    Using ASMLib from /opt/oracle/extapi/64/asm/orcl/1/libasm.so
    [ASM Library - Linux, version 3.0.0 (KABI_V3), Aug 26 2024 00:20]
    Discovered disk: ORCL:VOL1 [1044162 blocks (534610944 bytes), blksz
    512/512, maxio 524288 bytes, integrity none]
    Discovered disk: ORCL:VOL2 [1044162 blocks (534610944 bytes), blksz
    512/512, maxio 524288 bytes, integrity none]
    ```

Querying ASM Disk Information

You can query ASM disk information by either using the `oracleasm querydisk -i` or
`oracleasm discover -l` commands.

*   Use the `oracleasm querydisk -i` command to query detailed information about a
    specific ASM disk.

    ```
    sudo oracleasm querydisk -i VOL1
    ```

The following output might be displayed:

```
ORCL:VOL1
Device: /dev/sda1 (8:1)
Device UUID: naa.33333330000007d0-part1
Disk Group: DBTEST
Capabilities: IO | UDID | NOGLOBAL | LOGICAL | IO_LOGICAL
Size: 130520 blocks (534609920 bytes)
Logical Block Size: 512 bytes
Physical Block Size: 4096 bytes
Max I/O Size: 128 blocks (524288 bytes)
Data Integrity: T10-DIF-TYPE1-CRC
Thin Provisioning: supported
Max TP I/O Size: 8388607 blocks (4294966784 bytes)
```

The output fields are as follows:

Device
The ASM disk's block device node.

Device UUID
Universally unique identifier of the underlying storage hardware (if supported).

Disk Group
Name of the ASM Disk Group that the ASM disk belongs to.

Capabilities
Features implemented by this ASM disk.

Size
Storage capacity of the ASM disk.

Logical Block Size
The logical block size of the underlying storage hardware.

Physical Block Size
The physical block size of the underlying storage hardware.

Max I/O Size
Maximum I/O size supported by the underlying storage hardware.

Data Integrity
Indicates whether the ASM disk supports end-to-end data integrity protection. A value of
`T10-DIF-TYPE1-CRC` indicates that the device is formatted with T10 Protection Information,
Type 1, and that exchanging protection information with the underlying storage hardware
is enabled.

Thin Provisioning
Indicates whether the underlying storage hardware supports reclaiming unused space
through an `Unmap` operation.

Max TP I/O Size
Indicates the maximum size of an `Unmap` operation.

- To query detailed information about all ASM disks attached to the system use the `-l` option when you run the `oracleasm discover` command.

```
sudo oracleasm discover -l
```

The information printed for each ASM disk matches the output of the `oracleasm querydisk -i` command.