MariaDB and Entrust KeyControl Vault

Integration Guide

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Chapter 1. Introduction

This document describes the integration of MariaDB with the Entrust KeyControl Vault Management Solution (KMS).

1.1. Documents to read first

This guide describes how to configure the Entrust KeyControl Vault server as a KMS in MariaDB.

To install and configure the Entrust KeyControl Vault server, see the *Entrust KeyControl Vault nShield HSM Integration Guide*. You can access it from the Entrust Document Library and from the nShield Product Documentation website.

Also refer to the MariaDB online documentation.

1.2. Requirements

- Entrust KeyControl Vault version 10.2 or later

  An Entrust KeyControl license is required for the installation. You can obtain this license from your Entrust KeyControl Vault and MariaDB account team or through Entrust KeyControl Vault customer support.

- MariaDB Server 11.3.2 or later

  Entrust recommends that you allow only unprivileged connections unless you are performing administrative tasks.

1.3. High-availability considerations

Entrust KeyControl Vault uses an active-active deployment, which provides high-availability capability to manage encryption keys. Entrust recommends this deployment configuration. In an active-active cluster, changes made to any KeyControl node in the cluster are automatically reflected on all nodes in the cluster. For information about Entrust KeyControl, see the Entrust KeyControl Vault Product Overview.

1.4. Product configuration

The integration between the MariaDB Server and Entrust KeyControl Vault has been successfully tested in the following configurations:

Product	Version
MariaDB Server	11.3.2
Entrust KeyControl Vault	10.2
Red Hat Enterprise Linux 8.9	Kernel: Linux 4.18.0-513.18.1.el8_9.x86_64

Chapter 2. Procedures

2.1. Install the MariaDB Community Server

Installing the MariaDB Community Server depends on the operating system on which you are installing it. See the MariaDB documentation for details on how to install MariaDB in your environment.

This integration uses RedHat Linux 8 and the RHEL 8 and CentOS 8 guide from the MariaDB website.

CentOS 8 and RHEL 8 include MariaDB Community Server 10.3 but later MariaDB Server versions include substantial enhancements. Deploy MariaDB Community Server v11.3.2 on RHEL 8 or CentOS 8 using the `mariadb_repo_setup` script to configure the MariaDB repositories for YUM.

1. Download the script:

   ```
   % wget https://downloads.mariadb.com/MariaDB/mariadb_repo_setup
   ```

2. Run it:

   ```
   % chmod +x mariadb_repo_setup
   % sudo ./mariadb_repo_setup
   ```

3. Install dependencies:

   ```
   % sudo yum install perl-DBI libaio libsepol lsof boost-program-options galera-4
   ```

4. To avoid conflict with the OS-vendor package, use the `--repo` flag to specify in which repository to install the MariaDB server.

   ```
   % sudo yum install --repo="mariadb-main" MariaDB-server
   ```

5. Start the `systemd` service for MariaDB Server using `systemctl`:

   ```
   % sudo systemctl start mariadb.service
   ```

6. Check the status:

   ```
   % sudo systemctl status mariadb.service
   ```

```
● mariadb.service - MariaDB 11.3.2 database server
   Loaded: loaded (/usr/lib/systemd/system/mariadb.service; disabled; vendor preset: disabled)
  Drop-In: /etc/systemd/system/mariadb.service.d
           └─migrated-from-my.cnf-settings.conf
   Active: active (running) since Mon 2024-03-25 14:58:36 EDT; 7s ago
     Docs: man:mariadbd(8)
           https://mariadb.com/kb/en/library/systemd/
  Process: 52054 ExecStartPost=/bin/sh -c systemctl unset-environment _WSREP_START_POSITION (code=exited,
status=0/SUCCESS)
  Process: 52034 ExecStartPre=/bin/sh -c [ ! -e /usr/bin/galera_recovery ] && VAR= ||   VAR=`cd
/usr/bin/..; /usr/bin/galera_recovery`; [ $? -eq 0 ]   && systemctl set-environment _WSREP_START_POSI>
  Process: 52032 ExecStartPre=/bin/sh -c systemctl unset-environment _WSREP_START_POSITION (code=exited,
status=0/SUCCESS)
 Main PID: 52044 (mariadbd)
   Status: "Taking your SQL requests now..."
    Tasks: 12 (limit: 28458)
   Memory: 148.9M
   CGroup: /system.slice/mariadb.service
           └─52044 /usr/sbin/mariadbd

Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] Plugin 'FEEDBACK' is
disabled.
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] Plugin 'wsrep-provider' is
disabled.
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] InnoDB: Loading buffer
pool(s) from /var/lib/mysql/ib_buffer_pool
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] InnoDB: Buffer pool(s) load
completed at 240325 14:58:36
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] Server socket created on IP:
'0.0.0.0'.
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] Server socket created on IP:
'::'.
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] mariadbd: Event Scheduler:
Loaded 0 events
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: 2024-03-25 14:58:36 0 [Note] /usr/sbin/mariadbd: ready
for connections.
Mar 25 14:58:36 mariadb-redhat-8 mariadbd[52044]: Version: '11.3.2-MariaDB'  socket:
'/var/lib/mysql/mysql.sock'  port: 3306  MariaDB Server
Mar 25 14:58:36 mariadb-redhat-8 systemd[1]: Started MariaDB 11.3.2 database server.
```

7. Enable MariaDB so it starts after a reboot:

```
% sudo systemctl enable mariadb.service
```

8. Connect to MariaDB:

```
% mariadb

Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 3
Server version: 11.3.2-MariaDB MariaDB Server

Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [(none)]> quit
Bye
```

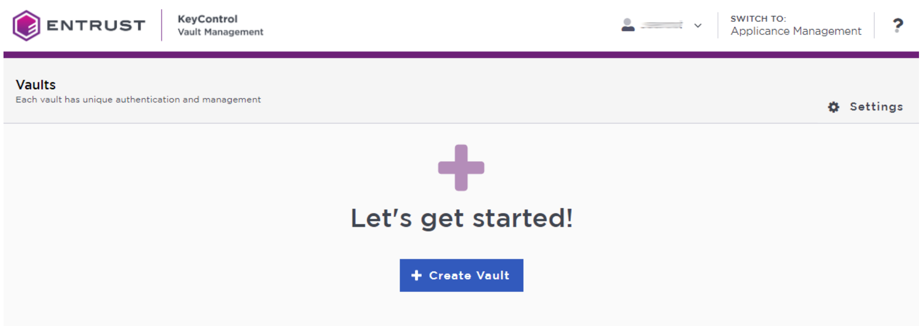
2.2. Install and configure Entrust KeyControl Vault

To install and configure Entrust KeyControl Vault, follow the installation and setup instructions in the *Entrust KeyControl Vault nShield HSM Integration Guide*. You can access it from the Entrust Document Library and from the nShield Product Documentation website.

2.2.1. Create a KeyControl database vault

The KeyControl Vault appliance supports several vault types. This section describes how to create a database vault in the KeyControl Vault Server, see Creating a Vault in the KeyControl Vault Management Admin Guide.

1. Sign in to the KeyControl Vault Server webGUI through a web browser, using the `secroot` credentials.
2. In the header menu, selec **SWITCH TO: Manage Vaults**.
3. In the KeyControl Vault Management page, select **Create Vault**.



4. Set the database vault properties:
   - For **Type**, select **Database**.
   - For **Name**, enter the name of the Vault.
   - For **Description**, enter the description of the Vault.
   - For **Admin Name**, enter the name of the administrator of the Vault.
   - For **Admin Email**, enter a valid email for the administrator.
5. Select **Create Vault**.

   A temporary password will be emailed to the administrator's email address. This is the password that will be used to sign in for the first time to the **Database Vault** space in KeyControl. The password for the user is displayed when you first create the vault. In a closed gap environment where email is not available, that can be copied and sent to the user.

6. Select **Close** when the Vault creation completes.

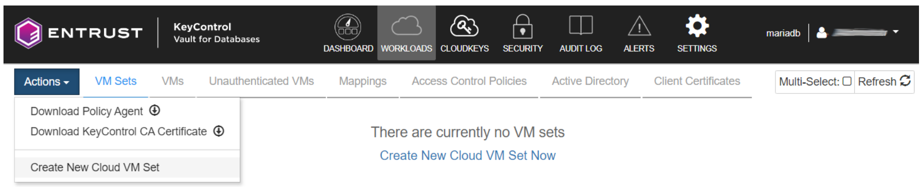
The new Vault is added to the Vault dashboard.

2.2.2. Configure the database vault for the integration with MariaDB

> MariaDB does not support envelope key encryption. The TDE key is stored in the KeyControl database vault. The key material is retrieved by the MariaDB database server during creation of encrypted tables.

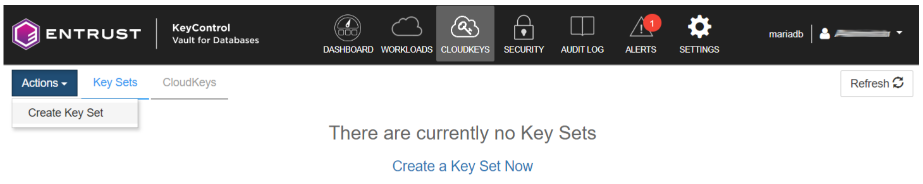
1. In the **Database Vault** space in KeyControl, find the vault URL. Hover over the vault and select **View Details**.
2. Sign in to the database vault through its vault URL. Use the login URL and credentials provided to the administrator of the vault.
3. Create a cloud VM set.

   Under **WORKLOADS** in the header menu, select **Actions > Create New Cloud VM Set**.



4. Enter the name of the VM set (**vmset1**), select **Create**, then select **Close**.
5. Create a key set.

   Under **CLOUDKEYS** in the header menu, select **Actions > Create Key Set**.



6. Set the key set properties:
   - Enter the name of the key set: **keyset1**.
   - Choose and Admin Group: **Cloud Admin Group**.
   - Select the Database Type: **MariaDB Database Server**.

    ◦ For **Allow Key Creation from MariaDB**: select **Yes**.

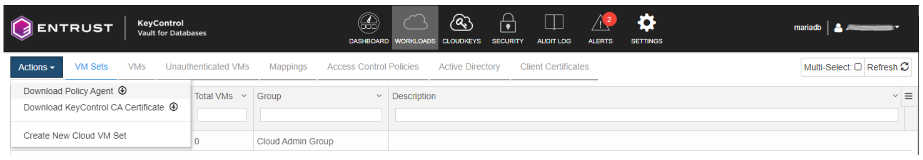
7. In the **HSM** Tab, clear the **Enable HSM** option. This integration does **not** link an HSM to KeyControl to generate cryptographic materials for cloudkeys in the key set.
8. In the **Schedule** tab, leave the **Rotation Schedule** at **Never**, select **Apply**, then select **Close**.

2.3. Install the KeyControl Policy Agent into the MariaDB server

You must install a copy of the KeyControl Policy Agent on the MariaDB server if you want to encrypt the server with KeyControl Vault.

The Entrust KeyControl Policy Agent is a software module that runs inside Windows and Linux operating systems that provides encryption of virtual disks and individual files. All servers that have the Policy Agent installed can also securely share encrypted files and disks. When a user attempts to access an encrypted disk, the Policy Agent queries KeyControl Vault to validate the request, and returns the information to the user if KeyControl Vault authorizes the request. See Policy Agent Installation.

1. Log into the KeyControl Database Vault webGUI.
2. In the header menu, select **WORKLOADS**.
3. Select **Actions > Download Policy Agent**.



4. From **Available Downloads** , download `hcs-client-agent.zip` and transfer it to the MariaDB server.
5. In the MariaDB server, unzip the policy agent file that you downloaded.

```
% unzip hcs-client-agent.zip

creating: hcs-client-agent/
inflating: hcs-client-agent/hcs-api-10.2-1020001189.tgz.chksum
creating: hcs-client-agent/windows/
inflating: hcs-client-agent/windows/hcs-client-agent-10.2-1020001189.exe.chksum
inflating: hcs-client-agent/windows/hcs-client-agent-10.2-1020001189.exe
inflating: hcs-client-agent/hcs-api-10.2-1020001189.tgz
creating: hcs-client-agent/linux/
inflating: hcs-client-agent/linux/hcs-client-agent-10.2-1020001189.run
```

```
inflating: hcs-client-agent/linux/hcs-client-agent-10.2-1020001189.run.chksum
```

6. As the `root` user, run `hcs-client-agent/linux/hcs-client-agent-10.2-1020001189.run`.

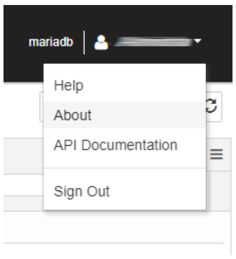
   ```
   % sudo ./hcs-client-agent/linux/hcs-client-agent-10.2-1020001189.run

   Verifying archive integrity...  100%   All good.
   Uncompressing hcs-client-agent-10.2-1020001189.run  100%
   x86_64
   No HyTrust Agent found on this system
   HyTrust Agent will be installed in /opt/hcs
   Specify location for installing HyTrust Agent (/opt/hcs):
   Created symlink /etc/systemd/system/multi-user.target.wants/hcld.service →
   /usr/lib/systemd/system/hcld.service.
   Platform is rhel

   You can now install online encryption driver, the process is described in the Admin Guide
   Please see the following section of Admin Guide for details
   Administration Guide > Data Encryption > Linux Encryption Overview

   Installation successful
   ```

7. Make sure you have all the information required for the policy agent installation. For details, see Policy Agent prerequisites.
   - The IP addresses of all KeyControl Vault nodes with which you want to register the Policy Agent, or one IP address and the name of the KeyControl Mapping you want to use on the server.
   - The credentials for a KeyControl webGUI user account with Cloud Admin privileges.
   - The name of the KeyControl Vault Cloud VM Set with which you want to associate the server.

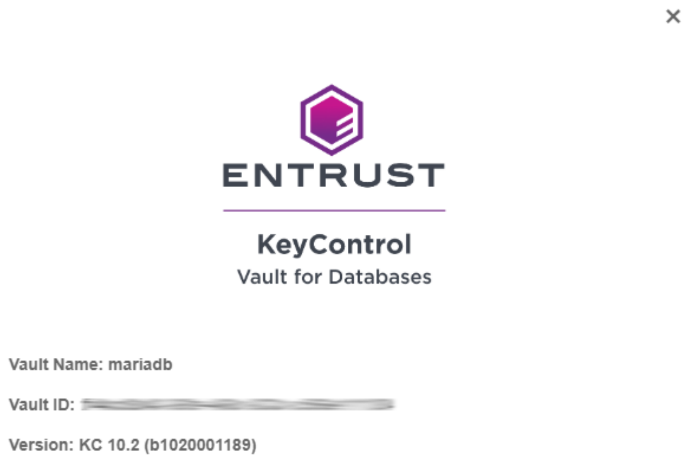
2.4. Register the MariaDB server with KeyControl Vault

This integration uses automated authentication. For authentication options for KeyControl vaults, see Policy Agent prerequisites.

1. In the KeyControl Database Vault webGUI, select the vault name in the top-right of the header menu, then select **About**.



2. Copy the `VAULT ID` from the screen.



Vault Name: mariadb

Vault ID: [redacted]

Version: KC 10.2 (b1020001189)

3. In the MariaDB server, run the following command to register the MariaDB server with KeyControl:

```
% hcl register -a <keycontrol-vault-ip> -v <VAULT ID>
```

Example:

```
% sudo hcl register -a 10.194.xxx.yyy -v f4cd6xxx-xxxx-xxxx-833c-c566e1111804

Please provide the Vault login details
username: user.name@webbdomain.com
password:

Available Cloud VM Sets
--------------------------------------------------------------------------------
1 : vmset1
--------------------------------------------------------------------------------

Please select a Cloud VM Set by number to which this VM should be added: 1

The selected Cloud VM Set is -- vmset1
Do you want to continue (y/n)?y
Registered as mariadb-redhat-8 with KeyControl node(s) 10.194.148.215

Completing authentication for mariadb-redhat-8 on KeyControl node(s) 10.194.148.215

Authentication complete, machine ready to use
Getting KeyControl Mapping information

KeyControl Mappings are not available
```

2.5. Enable TDE on the MariaDB server

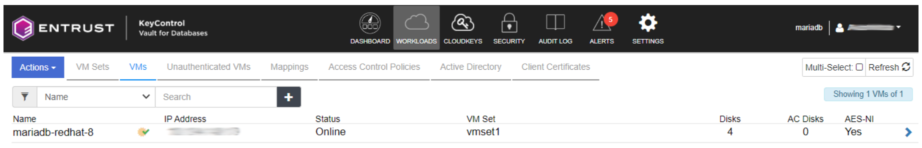
1. Enable TDE on the server.

```
% sudo hcs tde enable -y

Enabling tde will change permissions of some Files.
```

2. Check that the MariaDB server is now registered in the KeyControl Database Vault:

   In the KeyControl WebGUI header menu, select **WORKLOADS**, then select **VMs**.

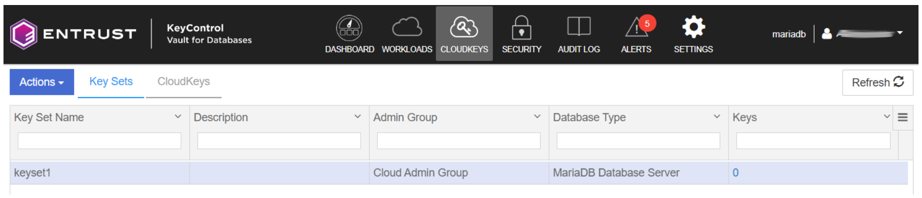
   You should see the MariaDB server listed there.



Name	IP Address	Status	VM Set	Disks	AC Disks	AES-NI
mariadb-redhat-8	[redacted]	Online	vmset1	4	0	Yes

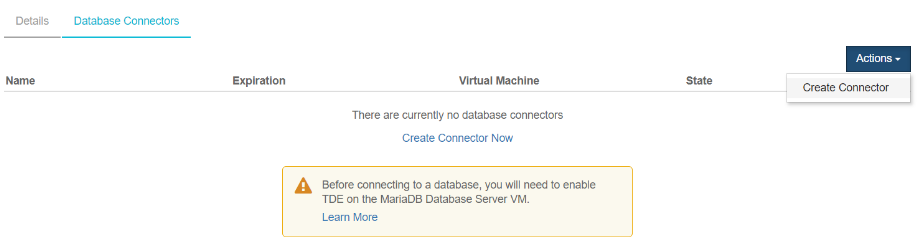
2.6. Create a database connector for the key set in the KeyControl Database Vault

1. Log into the KeyControl Database Vault webGUI.
2. In the header menu, select **CLOUDKEYS**, then select the key set that you created.



Key Set Name	Description	Admin Group	Database Type	Keys
keyset1		Cloud Admin Group	MariaDB Database Server	0

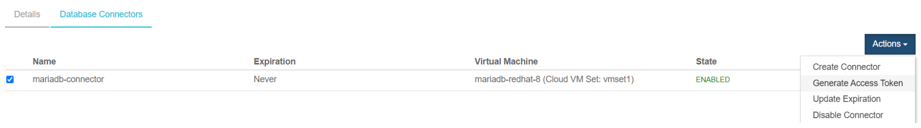
3. Select the **Database Connectors** tab.
4. Select **Actions > Create Connector**.



There are currently no database connectors

Before connecting to a database, you will need to enable TDE on the MariaDB Database Server VM.

5. Set the database connector properties, then select **Create**,
    - **VM Name**: Select the Maria DB server you registered earlier (**mariadb-redhat-8 (vmset1)**).
    - **Connector Name**: The name of the connector (**mariadb-connector1**).
6. Select **Actions > Generate Access Token**.



	Name	Expiration	Virtual Machine	State
✓	mariadb-connector	Never	mariadb-redhat-8 (Cloud VM Set: vmset1)	ENABLED

7. In the **Generate Access Token** dialog, select **Generate Token**.
8. Copy and save the **Identity** and **Secret** data that you will need later in the integration process.

    You won’t be able to retrieve this data later.

```
Identity: mariadb-connector
Secret: ...
```

2.7. Create a Maria DB config file with the information about the connector

1. Sign in to the MariaDB server.
2. Change to the `/opt/hcs/etc` directory:

```
% cd /opt/hcs/etc
```

3. Create a `mdb.conf` file:

```
% sudo vi mdb.conf
```

4. Place the database connector access token information created earlier into the file.

```
{
    "identity" : "mariadb-connector",
    "secret" : "..."
}
```

2.8. Link the KeyControl library in the MariaDB plugins directory

1. Change to the plugins directory:

```
% cd /usr/lib64/mysql/plugin
```

2. Create the link to the library:

```
% sudo ln -s /opt/hcs/lib/entrust_key_management.so
```

3. Check the link:

```
% ls -al entrust_key_management.so

lrwxrwxrwx. 1 root root 38 Mar 28 11:29 entrust_key_management.so -> /opt/hcs/lib/entrust_key_management.so
```

4. Restart the MariaDB server:

```
% sudo systemctl restart mariadb
```

5. Run the query to install the plugin:

   Invoke MariaDB as a user with `root` privileges.

   Run the **INSTALL SONAME** query to install the plugin.

```
% sudo mariadb

Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 14
Server version: 11.3.2-MariaDB MariaDB Server

Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

MariaDB [(none)]> INSTALL SONAME 'entrust_key_management';
Query OK, 0 rows affected (0.646 sec)
```

6. Check that the plugin is installed and active:

```
MariaDB [(none)]> show plugins;

+--------------------------------+---------+-------------------+---------------------------+---------+
| Name                           | Status  | Type              | Library                   | License |
+--------------------------------+---------+-------------------+---------------------------+---------+
| entrust_key_management         | ACTIVE  | ENCRYPTION        | entrust_key_management.so | GPL     |
+--------------------------------+---------+-------------------+---------------------------+---------+
```

2.9. Test encryption using the KeyControl database vault

This section shows examples how to create tables with encryption that uses the KeyControl database vault that you created.

The examples use the test database available in MariaDB:

```
MariaDB [(none)]> show databases;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| test               |
+--------------------+
2 rows in set (0.001 sec)
```

If you get the following error, run `mariadb` as `root`.

```
ERROR 1227 (42000): Access denied; you need (at least one of) the PROCESS privilege(s) for this operation
```

2.9.1. Example 1: Create a table without specifying a key

```
MariaDB [test]> create table table1 (i int) ENGINE=InnoDB ENCRYPTED=YES;
Query OK, 0 rows affected (0.148 sec)
```

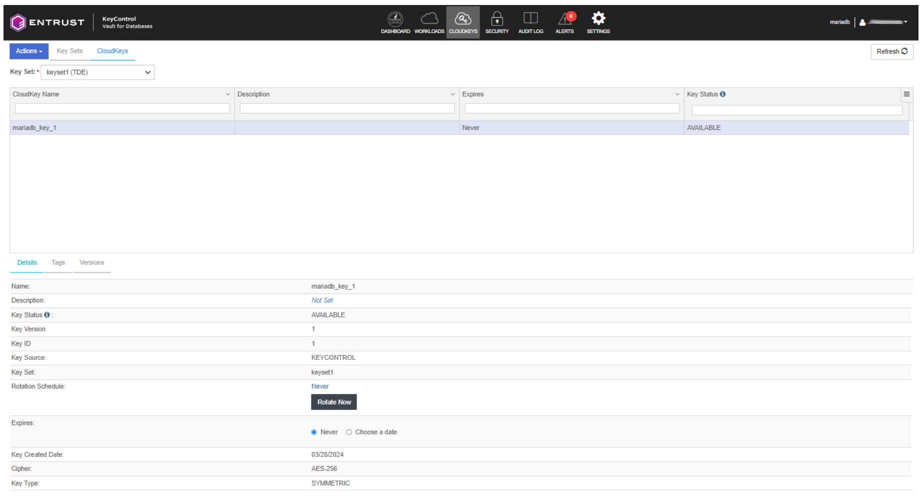
No key was specified, so MariaDB will try to use the first key it finds in the key set with key ID = 1. When the VM set and key set was created, the flag to allow creation of keys was set. This means that if the first key does not exist, it will be automatically created. If this flag was not set when the VM set and key set was created, you first have to create the key in the KeyControl database vault before running the `create table` command.

1. Go to the KeyControl database server and look for the key in the key set.

   Select **CLOUDKEYS** in the header menu, then select **CloudKeys**.

   For Key Set: Select the key set you created earlier (**keyset1**)

2. You should see the first key that was automatically created (**mariadb_key_1**) and its key ID is set to 1.



Key Set: * keyset1 (TDE)

CloudKey Name	Description	Expires	Key Status
mariadb_key_1		Never	AVAILABLE

Name:	mariadb_key_1
Description:	*Not Set*
Key Status:	AVAILABLE
Key Version	1
Key ID	1
Key Source:	KEYCONTROL
Key Set:	keyset1
Rotation Schedule:	Never
Expires:	[✓ Never] Choose a date
Key Created Date:	03/28/2024
Cipher:	AES-256
Key Type:	SYMMETRIC

You can also see similar information by running the following command:

```
MariaDB [(none)]> select * from information_schema.innodb_tablespaces_encryption G;
+-------------+-----------------+---------------------+----------------+
| NAME        | MIN_KEY_VERSION | CURRENT_KEY_VERSION | CURRENT_KEY_ID |
+-------------+-----------------+---------------------+----------------+
| test/table1 |               1 |                   1 |        ==>   1 |
+-------------+-----------------+---------------------+----------------+
1 row in set (0.069 sec)
```

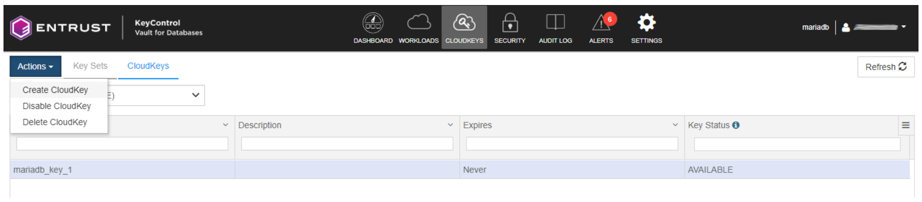
The `CURRENT_KEY_ID` field is set to 1, which is the first key in the key set.

2.9.2. Example 2: Create a table specifying a key created by the user in the KeyControl database vault

1. Create a key in the KeyControl database vault so it can be used with the `create table` command.

   In the KeyControl database vault, select **CLOUDKEYS** in the header menu, then select **CloudKeys**.

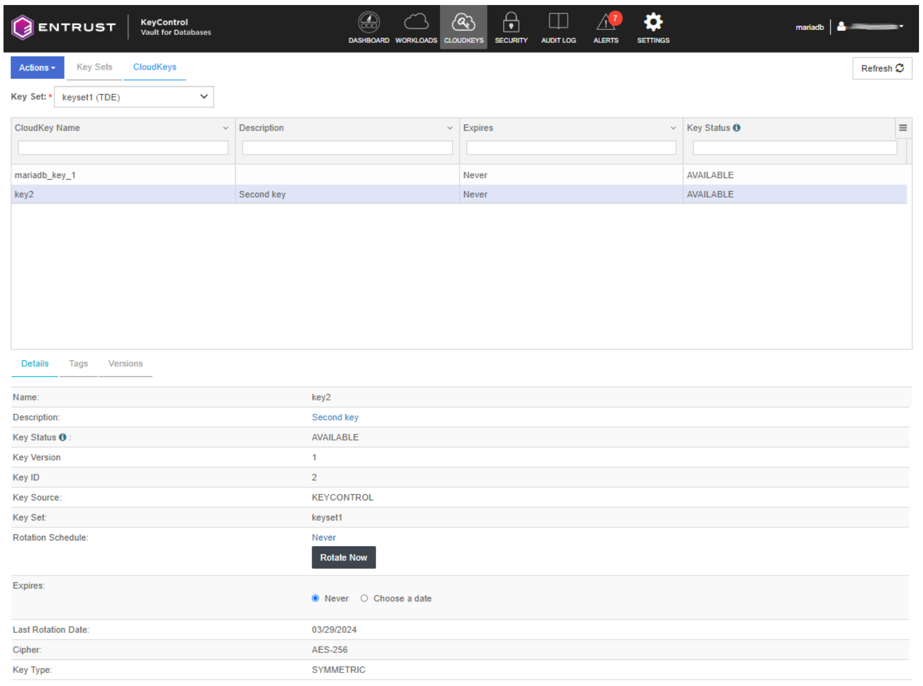
2. Selec **Actions > Create CloudKey**.



	Description	Expires	Key Status
mariadb_key_1		Never	AVAILABLE

3. Set the properties of the new cloudkey, then select **Continue**.
   - **Name**: Name of the key (**key2**)
   - **Cipher**: Select **AES-256**

4. Select **Schedule > Apply** to create the key.



Key Set: * keyset1 (TDE)

CloudKey Name	Description	Expires	Key Status
mariadb_key_1		Never	AVAILABLE
key2	Second key	Never	AVAILABLE

Details Tags Versions

Name:	key2
Description:	Second key
Key Status :	AVAILABLE
Key Version	1
Key ID	2
Key Source:	KEYCONTROL
Key Set:	keyset1
Rotation Schedule:	Never
Expires:	[✓ Never] Choose a date
Last Rotation Date:	03/29/2024
Cipher:	AES-256
Key Type:	SYMMETRIC

5. Back in the MariaDB server, create a table using the new encryption key.

```
MariaDB [test]> create table table2 (i int) ENGINE=InnoDB ENCRYPTED=YES ENCRYPTION_KEY_ID=2;
Query OK, 0 rows affected (0.158 sec)
```

We specify the key ID and not the key name in the command. If you look at the key ID for **key2**, you will see that it is 2.

6. Run the command to show what key ID is used by each table.

```
MariaDB [(none)]> select * from information_schema.innodb_tablespaces_encryption G;
+------------+----------------+--------------------+---------------+
| NAME       | MIN_KEY_VERSION | CURRENT_KEY_VERSION | CURRENT_KEY_ID |
+------------+----------------+--------------------+---------------+
| test/table1 |              1 |                  1 |             1 |
| test/table2 |              1 |                  1 |        ==>  2 |
+------+--------------------+--------------------+---------------+
2 rows in set (0.147 sec)
```

The `CURRENT_KEY_ID` for `table2` is 2.

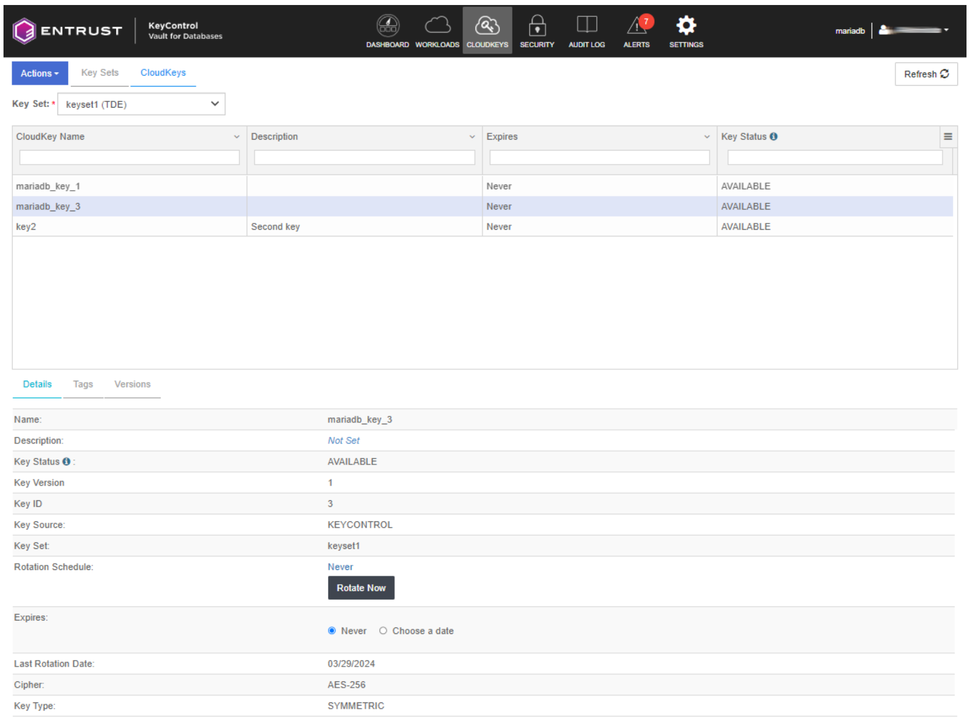
2.9.3. Example 3: Create a table specifying a key that does not exist in the KeyControl database vault

In this example we are going to create the table with a key ID that does not exist yet. The command is similar to Example 1 but in this example we are going to create the new key with a specific ID. The same applies here, the key will be created because the VM set allows the creation of the key.

1. Create a new key:

```
MariaDB [test]> create table table3 (i int) ENGINE=InnoDB ENCRYPTED=YES ENCRYPTION_KEY_ID=3;
Query OK, 0 rows affected (0.515 sec)
```

2. Check the new key (**mariadb_key3***) with key ID = 3 in the KeyControl database vault:



Key Set: * keyset1 (TDE)

CloudKey Name	Description	Expires	Key Status
mariadb_key_1		Never	AVAILABLE
mariadb_key_3		Never	AVAILABLE
key2	Second key	Never	AVAILABLE

Name:	mariadb_key_3
Description:	*Not Set*
Key Status :	AVAILABLE
Key Version	1
Key ID	3
Key Source:	KEYCONTROL
Key Set:	keyset1
Rotation Schedule:	Never
Expires:	[✓ Never] Choose a date
Last Rotation Date:	03/29/2024
Cipher:	AES-256
Key Type:	SYMMETRIC

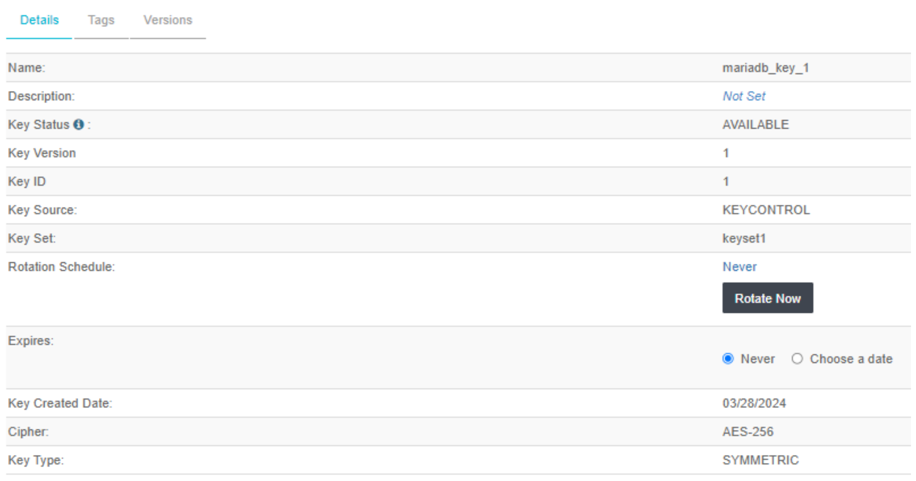
1. Look up the information in `mariadb`. `table3` uses the new key.

```
MariaDB [(none)]> select * from information_schema.innodb_tablespaces_encryption G;
+------------+-----------------+--------------------+----------------+
| NAME       | MIN_KEY_VERSION | CURRENT_KEY_VERSION | CURRENT_KEY_ID |
+------------+-----------------+--------------------+----------------+
| test/table1 |               1 |                  1 |              1 |
| test/table2 |               1 |                  1 |              2 |
| test/table3 |               1 |                  1 |         ==>  3 |
+------------+-----------------+--------------------+----------------+
3 rows in set (0.172 sec)
```

2.9.4. Example 4: Key rotation

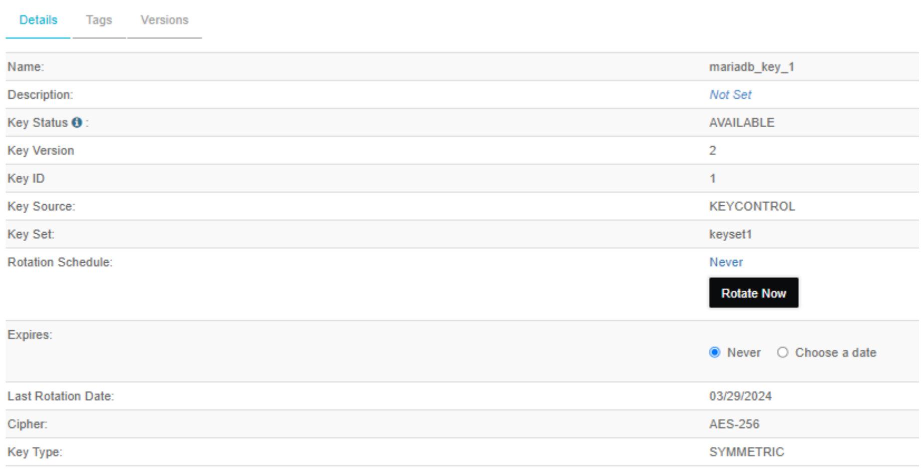
The rotation of keys is performed in the KeyControl database vault.

1. Select first key with key ID = 1 for rotation.
2. Select **Details > Rotate Now**.



Name:	mariadb_key_1
Description:	Not Set
Key Status:	AVAILABLE
Key Version	1
Key ID	1
Key Source:	KEYCONTROL
Key Set:	keyset1
Rotation Schedule:	Never
Expires:	[✓ Never] Choose a date
Key Created Date:	03/28/2024
Cipher:	AES-256
Key Type:	SYMMETRIC

After the rotation, the **Key Version** will get incremented by 1. In this example, the incremented value will be 2.



Name:	mariadb_key_1
Description:	Not Set
Key Status:	AVAILABLE
Key Version	2
Key ID	1
Key Source:	KEYCONTROL
Key Set:	keyset1
Rotation Schedule:	Never
Expires:	[✓ Never] Choose a date
Last Rotation Date:	03/29/2024
Cipher:	AES-256
Key Type:	SYMMETRIC

3. Look up the information in `mariadb`. `table1` is now using version 2 of the first key.

```
MariaDB [(none)]> select * from information_schema.innodb_tablespaces_encryption G;
+-------------+-----------------+---------------------+----------------+
| NAME        | MIN_KEY_VERSION | CURRENT_KEY_VERSION | CURRENT_KEY_ID |
+-------------+-----------------+---------------------+----------------+
| test/table1 |               1 |           ==>    2  |         ==>  1 |
| test/table2 |               1 |                  1  |              2 |
| test/table3 |               1 |                  1  |              3 |
+-------------+-----------------+---------------------+----------------+
```

4. If you create another encrypted table without specifying the encryption key ID, version 2 of the first key will be used for that table.

```
MariaDB [test]> create table table4 (i int) ENGINE=InnoDB ENCRYPTED=YES;
Query OK, 0 rows affected (0.145 sec)
```

5. Look up the information in `mariadb`. `table4` is using version 2 of the first key.

```
MariaDB [test]> select * from information_schema.innodb_tablespaces_encryption G;
+------------+-----------------+---------------------+----------------+
| NAME       | MIN_KEY_VERSION | CURRENT_KEY_VERSION | CURRENT_KEY_ID |
+------------+-----------------+---------------------+----------------+
| test/table1 |              1 |                   2 |              1 |
| test/table2 |              1 |                   1 |              2 |
| test/table3 |              1 |                   1 |              3 |
| test/table4 |              2 |          ==>      2 |        ==>   1 |
+------------+-----------------+---------------------+----------------+
4 rows in set (0.249 sec)
```

2.9.5. Example 5: Encrypt an existing table

1. Create the table without encryption:

```
MariaDB [test]> create table table5 (i int);
Query OK, 0 rows affected (0.013 sec)
```

2. Encrypt the table. Use key ID 2 for the encryption.

```
MariaDB [test]> alter table table5 ENCRYPTED=YES ENCRYPTION_KEY_ID=2;
Query OK, 0 rows affected (0.144 sec)
Records: 0  Duplicates: 0  Warnings: 0
```

3. Look up the information in `mariadb`. `table2` and `table5` are using version 1 of the second key:

```
MariaDB [test]> select * from information_schema.innodb_tablespaces_encryption G;
+------------+-----------------+---------------------+----------------+
| NAME       | MIN_KEY_VERSION | CURRENT_KEY_VERSION | CURRENT_KEY_ID |
+------------+-----------------+---------------------+----------------+
| test/table1 |              1 |                   2 |              1 |
| test/table2 |              1 |             ==>   1 |         ==>  2 |
| test/table3 |              1 |                   1 |              3 |
| test/table4 |              2 |                   2 |              1 |
| test/table5 |              1 |             ==>   1 |         ==>  2 |
+------------+-----------------+---------------------+----------------+
5 rows in set (0.335 sec)
```

Chapter 3. Additional resources and related products

3.1. nShield Connect

3.2. nShield as a Service

3.3. KeyControl

3.4. Entrust digital security solutions

3.5. nShield product documentation