THALES

Oracle Key Vault: Integration Guide

THALES LUNA HSM AND DPOD LUNA CLOUD HSM

Document Information

Document Part Number	007-000318-001
Revision	F
Release Date	21 January 2022

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Overview

This document guides security administrators through the steps for integrating Oracle Key Vault with a Luna HSM or Luna Cloud HSM. You can use Luna HSMs to secure the Root of Trust (RoT) for Oracle Key Vault. The Luna HSM RoT protects the wallet password, which protects the TDE master key, which in turn protects all the encryption keys, certificates, and other security artifacts managed by Oracle Key Vault. The Luna HSM does not store any customer encryption keys. The customer keys are stored and managed directly by the Oracle Key Vault server.

The benefits of securing the cryptographic keys with Luna HSMs include:

- Secure generation, storage, and protection of the keys on FIPS 140-2 level 3 validated hardware.
- Full life cycle management of the keys.
- HSM audit trail*.
- Significant performance improvements by off-loading cryptographic operations from application servers.

*Luna Cloud HSM service does not have access to the secure audit trail

Certified Platforms

- Certified platforms for Luna HSM
- Certified platforms for Luna Cloud HSM

Certified platforms for Luna HSM

The following platforms are certified for integrating Oracle Key Vault with Luna HSM:

HSM Type	Platforms Certified	Luna Client Version
Luna HSM	Oracle Key Vault v21.3.0.0.0 with Multi-Master Cluster	UC 10.4
	Oracle Key Vault v21.1.0.0.0	UC 10.3
	Oracle Key Vault v18.5.0.0.0 with Multi-Master Cluster Oracle Key Vault v18.4.0.0.0 Oracle Key Vault v18.1.0.0.0 Oracle Key Vault v12.2.0.8	UC 10.2

NOTE: This integration is tested in both HA and FIPS mode.

Luna HSM: Luna HSM appliances are purposefully designed to provide a balance of security, high performance, and usability that makes them an ideal choice for enterprise, financial, and government organizations. Luna HSMs physically and logically secure cryptographic keys and accelerate cryptographic processing. The Luna HSM on premise offerings include the Luna Network HSM, Luna PCIe HSM, and

Luna USB HSMs. Luna HSMs are also available for access as an offering from cloud service providers such as IBM cloud HSM and AWS cloud HSM classic.

Certified platforms for Luna Cloud HSM

The following platforms are certified for integrating Oracle Key Vault with Luna Cloud HSM:

HSM Type	Platforms Certified
Luna Cloud HSM	Oracle Key Vault v21.1.0.0.0

Luna Cloud HSM: Luna Cloud HSM platform provides on-demand, cloud-based HSM and Key Management services through a simple graphical user interface. With Luna Cloud HSM, security is simple, cost effective and easy to manage because there is no hardware to buy, deploy and maintain. As an Application Owner, you click and deploy services, generate usage reports and maintain just the services you need.

Prerequisites

Before beginning the integration, ensure you have completed the following tasks:

> Configure Luna HSM

> Configure Luna Cloud HSM service

> Set up Oracle Key Vault

Configure Luna HSM

To configure Luna HSM:

1. Ensure the HSM is setup, initialized, provisioned, and ready for deployment.
2. Create a partition on the HSM for use by Oracle Key Vault.
3. Create and exchange certificate between the Luna Network HSM and Client system. Register client and assign partition to create an NTLS connection. Initialize Crypto Officer and Crypto User roles for the registered partition.
4. Verify that the partition is successfully registered and configured. The command to see the registered partition is:

```
# /usr/safenet/lunaclient/bin/lunacm

lunacm (64-bit) v10.2.0-111. Copyright (c) 2020 SafeNet. All rights
reserved.

        Available HSMs:
        Slot Id ->              0
        Label ->                OKV
        Serial Number ->        1238696044950
        Model ->                LunaSA 7.4.0
        Firmware Version ->     7.4.0
        Configuration ->        Luna User Partition With SO (PW) Key Export
                                With Cloning Mode
```

```
Slot Description ->     Net Token Slot
FM HW Status ->         Non-FM
Current Slot Id: 0
```

5. For PED-authenticated HSM, enable partition policies 22 and 23 to allow activation and auto-activation.

> **NOTE:** Follow the Luna Network Luna HSM documentation for detailed steps for creating NTLS connection, initializing the partitions, and managing various user roles.

To control user access to HSM

> **NOTE:** This section is applicable only for Linux users.

By default, only the root user has access to the HSM. You can specify a set of non-root users that are permitted to access the HSM, by adding them to the **hsmusers** group. The client software installation automatically creates the **hsmusers** group. The **hsmusers** group is retained when you uninstall the client software, allowing you to upgrade the software while retaining your **hsmusers** group configuration.

To add a user to hsmusers group

To allow non-root users or applications access to the HSM, assign the users to the **hsmusers** group. The users you assign to the **hsmusers** group must exist on the client workstation.

1. Ensure that you have **sudo** privileges on the client workstation.
2. Add a user to the hsmusers group.

   ```
   # sudo gpasswd --add <username> hsmusers
   ```

   Where `<username>` is the name of the user you want to add to the hsmusers group.

To remove a user from hsmusers group

1. Ensure that you have sudo privileges on the client workstation.
2. Remove a user from the hsmusers group.

   ```
   # sudo gpasswd -d <username> hsmusers
   ```

   Where `<username>` is the name of the user you want to remove from the **hsmusers** group. You must log in again to see the change.

> **NOTE:** The user you delete will continue to have access to the HSM until you reboot the client workstation.

To set up Luna HSM High-Availability (HA)

Please refer to the Luna HSM documentation for HA steps and details regarding configuring and setting up two or more HSM appliances on UNIX systems. You must enable the HAOnly setting in HA for failover to work so that if primary stop functioning for some reason, all calls automatically routed to secondary till primary starts functioning again.

Configure Luna Cloud HSM service

You can configure Luna Cloud HSM Service in the following ways:

> Standalone Cloud HSM service using minimum client package

> Standalone Cloud HSM service using full Luna client package

> Luna HSM and Luna Cloud HSM service in hybrid mode

NOTE: Luna Client v10.x or higher is required for configuring Luna HSM device and Luna Cloud HSM service in hybrid mode.

Standalone Cloud HSM service using minimum client package

To configure Luna Cloud HSM service using minimum client package:

1. Transfer the downloaded .zip file to your Client workstation using pscp, scp, or other secure means.
2. Login as root to the Oracle Key Vault server and create a directory /usr/safenet/lunaclient

   ```
   # mkdir -p /usr/safenet/lunaclient
   ```

3. Extract the .zip file into a /usr/safenet/lunaclient directory created above on your client workstation.
4. Extract or untar the appropriate client package for your operating system. Do not extract to a new subdirectory; place the files in the client install directory.

   ```
   [Linux]

   cvclient-min.tar

   # tar -xvf cvclient-min.tar
   ```

5. Run the setenv script to create a new configuration file containing information required by the Luna Cloud HSM service.

   ```
   [Linux]

   Source the setenv script.

   # source ./setenv
   ```

6. Run the LunaCM utility and verify that the Cloud HSM service is listed.

   NOTE: Follow the Luna Cloud HSM documentation for detailed steps for creating service, client, and initializing various user roles.

7. Create a directory /usr/safenet/lunaclient/lib/

   ```
   # mkdir /usr/safenet/lunaclient/lib/
   ```

8. Create a link of /usr/safenet/lunaclient/libs/64/libCryptoki2.so library to /usr/safenet/lunaclient/lib/libCryptoki2_64.so.

   ```
   # ln -svf /usr/safenet/lunaclient/libs/64/libCryptoki2.so
   /usr/safenet/lunaclient/lib/libCryptoki2_64.so
   ```

9. Copy the Chrystoki.conf file to /etc directory.

   ```
   # cp /usr/safenet/lunaclient/Chrystoki.conf /etc/
   ```

Standalone Cloud HSM service using full Luna client package

To configure Luna Cloud HSM service using full Luna client package:

1. Transfer the downloaded .zip file to your Client workstation using pscp, scp, or other secure means.
2. Extract the .zip file into a directory on your client workstation.
3. Extract or untar the appropriate client package for your operating system. Do not extract to a new subdirectory; place the files in the client install directory.

   ```
   [Linux]

   cvclient-min.tar

   # tar -xvf cvclient-min.tar
   ```

4. Run the setenv script to create a new configuration file containing information required by the Luna Cloud HSM service.

   ```
   [Linux]

   Source the setenv script.

   # source ./setenv
   ```

5. Copy the server and partition certificates from the Cloud HSM service client directory to Luna client certificates directory:

   NOTE: Skip this step for Luna Client v10.2 or higher.

   Cloud HSM Certificates

   ```
   server-certificate.pem

   partition-ca-certificate.pem

   partition-certificate.pem
   ```

   LunaClient Certificate Directory

   ```
   [Linux default location for Luna Client]

   /usr/safenet/lunaclient/cert/
   ```

6. Open the configuration file from the Cloud HSM service client directory and copy the XTC and REST section.

   Linux

   ```
   Chrystoki.conf
   ```

7. Edit the Luna Client configuration file and add the XTC and REST sections copied from Cloud HSM service client configuration file.
8. Change server and partition certificates path from step 5 in XTC and REST sections. Do not change any other entries provided in these sections.

   NOTE: Skip this step for Luna Client v10.2 or higher.

   [XTC]

   ```
   . . .
   ```

```
PartitionCAPath=<LunaClient_cert_directory>\partition-ca-certificate.pem
PartitionCertPath00=<LunaClient_cert_directory>\partition-certificate.pem
. . .

[REST]
. . .
SSLClientSideVerifyFile=<LunaClient_cert_directory>\server-certificate.pem
. . .
```

9. Edit the following entry from the Misc section and update the correct path for the plugins directory:

```
Misc]
PluginModuleDir=<LunaClient_plugins_directory>

[Linux Default]

/usr/safenet/lunaclient/plugins/
```

10. Save the configuration file. If you wish, you can now safely delete the extracted Cloud HSM service client directory.
11. Reset the ChrystokiConfigurationPath environment variable and point back to the location of the Luna Client configuration file.

    Linux

    Either open a new shell session, or export the environment variable for the current session pointing to the location of the Chrystoki.conf file:

    ```
    # export ChrystokiConfigurationPath=/etc/
    ```

12. Run the LunaCM utility and verify that the Cloud HSM service is listed. In hybrid mode, both Luna and Cloud HSM service will be listed.

> **NOTE:** Refer to Luna Cloud HSM documentation for detailed steps for creating service, client, and initializing various user roles.

Luna HSM and Luna Cloud HSM service in hybrid mode

To configure Luna HSM and Luna Cloud HSM service in hybrid mode, follow the steps mentioned under the Standalone Cloud HSM service using full Luna client package section above.

> **NOTE:** Luna Client v10.x or higher is required for configuring Luna HSM device and Luna Cloud HSM service in hybrid mode.

To use Luna Cloud HSM Service in FIPS mode

Cloud HSM service operates in both FIPS and non-FIPS mode. If your organization requires non-FIPS algorithms for your operations, enable the Allow non-FIPS approved algorithms check box when configuring your Cloud HSM service. The FIPS mode is enabled by default. Refer to the Mechanism List in the SDK Reference Guide for more information about available FIPS and non-FIPS algorithms.

Set up Oracle Key Vault

Oracle Key Vault is a software appliance that is delivered as an ISO image. We recommend installing Oracle Key Vault on its own dedicated physical server. The Oracle Key Vault ISO image consists of a pre-configured operating system, an Oracle database, and the Oracle Key Vault application.

For detailed information about installing Oracle Key Vault, refer to *Oracle Key Vault Documentation.*

Configuring Oracle Key Vault to use Thales Luna HSM

This section demonstrates how to initialize the Luna HSM so that a root of trust (RoT) can be created and used by Oracle Key Vault. To configure Oracle Key Vault to use Luna HSM:

1. Add the Oracle user to the **hsmusers** group and reboot the Oracle Key Vault for the change to take effect. Login with support user and then switch to root to perform below steps.

   ```
   # gpasswd --add oracle hsmusers
   ```

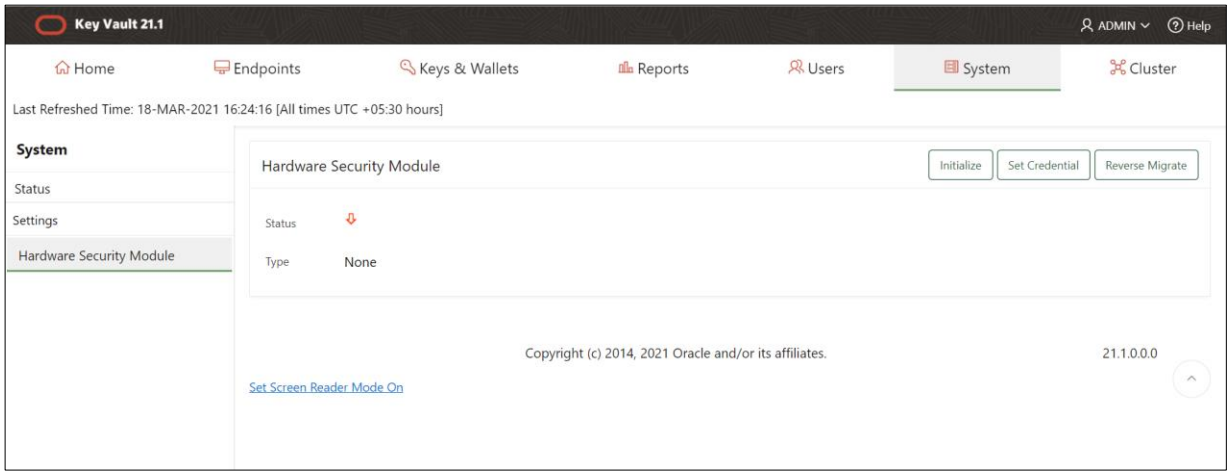
   ```
   # reboot
   ```

   > **NOTE:** Skip this step if you are using *Standalone Cloud HSM service using minimum client package*.

2. Oracle Key Vault provides a management console which can be accessed through `https://<Oracle_Key_Vault_Server_IP>` in the web browser.
3. Log in to the Oracle Key Vault management console as a user with system administrative privileges.

   > **NOTE:** The System Admin user credentials are created during Oracle Key Vault installation and configuration.

4. Click the **System** tab.
5. For Oracle Key Vault v21.1 or above in the left sidebar, click **Settings**. Under **Network Services**, click on **HSM**.
6. For Oracle Key Vault v18.5 or below in the left sidebar, click **Hardware Security Module**.
7. At this point, the HSM is not initialized. You will see a red arrow pointing down in the **Status** field.



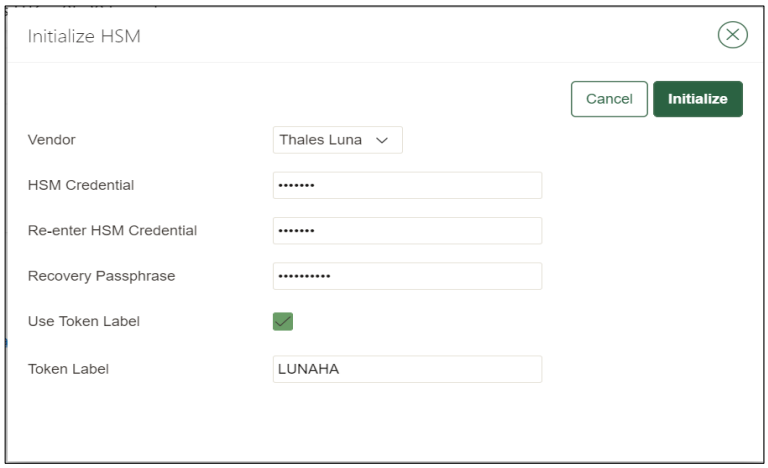
8. Click **Initialize**. The **Initialize HSM** dialog will appear on the screen.

9. Open the **Vendor** drop-down menu and select **Thales Luna**.

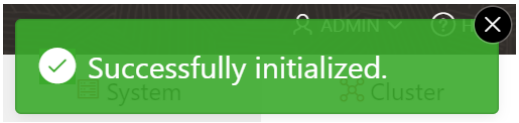
> **NOTE:** In earlier versions of Oracle Key Vault (18.4 or lower), open the Vendor drop-down menu and select Safenet.

10. Enter the **HSM Credential** and **Recovery Passphrase**. The HSM Credential is the partition password. The Recover Passphrase was set during the Post Installation setup of Oracle Key Vault. Select the **Use Token Label** checkbox and then enter the **Token Label**.

> **NOTE:** Earlier versions of Oracle Key Vault (18.3 or lower) do not support selecting Token Label. Using Token Label you can choose any token if multiple tokens are registered.



11. Click **Initialize**. On success, you will see the following message.



12. Once initialized, verify the HSM **Status**. You will see a green arrow pointing up with partition HSM details.

> **NOTE:** If you change the HSM credential following HSM initialization, you also need to update the HSM credential on the Oracle Key Vault server using the **Set Credential** button.

13. Verify the master encryption key generated on the partition by executing partition contents in lunacm.

```
lunacm:>par con

        The 'Crypto Officer' is currently logged in. Looking for objects
        accessible to the 'Crypto Officer'.

        Object list:

        Label:          OKV 18.1 HSM Key Number
        Handle:         115
        Object Type:    Data
        Object UID:     5600000025000003cb640800

        Label:          OKV 18.1 HSM Root Key
        Handle:         96
        Object Type:    Symmetric Key
        Usage Limit:    none
        Object UID:     5400000025000003cb640800


        Number of objects:  2


Command Result : No Error


lunacm:>
```

This completes the Integration of Oracle Key Vault with Thales Luna HSM.

Backing up and restoring Oracle Key Vault in HSM Mode

You can back up and restore Key Vault data when HSM mode is enabled. It is recommended that you should back up data periodically to reduce down time and recover from unexpected data losses and system failures. Backup can be done on local as well as on remote destination, but it is advised to choose remote destination. There are two types of backups: **One-Time** and **Periodic**. For the purpose of demonstration, this guide uses **One-Time** backup.

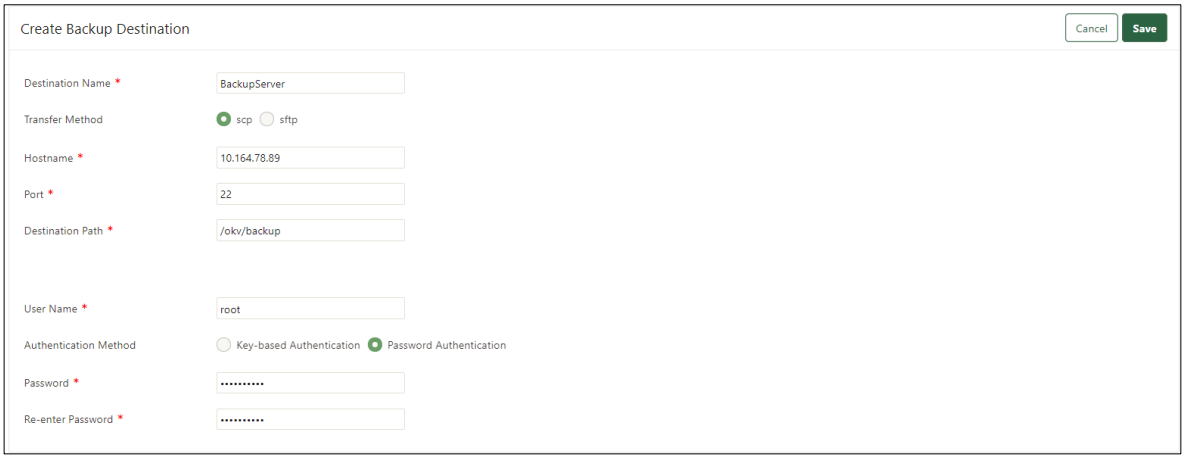
> Back up Oracle Key Vault in HSM mode

> Restore Oracle key Vault in HSM mode

Back up Oracle Key Vault in HSM mode

1. Log in to the Oracle Key Vault management console as a user with System Administrator privileges.
2. For Oracle Key Vault v21.1 or above, select the **System→Settings** and then click **Backup and Restore** under **System Configuration**. A list of scheduled and completed backups will be displayed.
3. For Oracle Key Vault v18.5 or below, select the **System** tab and then click **System Backup** on the left sidebar. A list of scheduled and completed backups will be displayed.
4. Click **Manage Backup Destinations**. This will display a list of all backup destinations.
5. Click **Create**.
6. Enter the following information for the backup location:
   - **Destination Name:** Specify any destination name.
   - **Transfer Method:** This is by default set to SCP to allow secure copy of files.

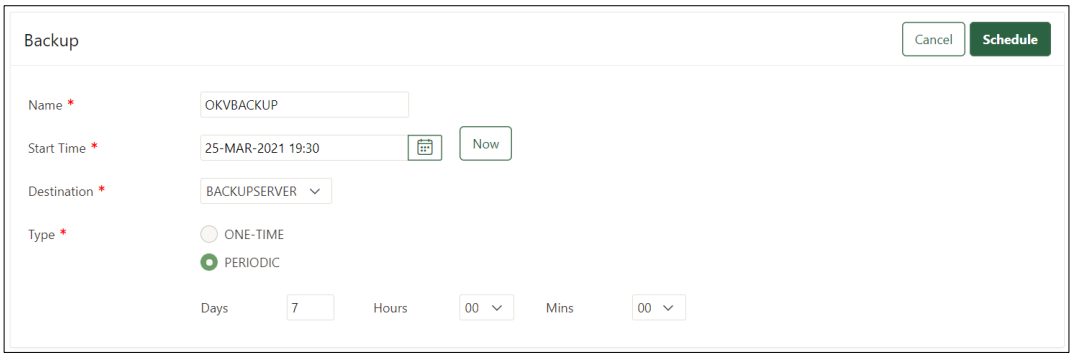
- **Hostname:** Enter the IP address of the backup destination. If DNS is configured enter the Hostname.
- **Port:** Enter Port number for SCP. The default port number is `22`.
- **Destination Path:** Enter the Actual path on the backup destination.
- **Username:** Enter the username who has read-write permission of Destination Path.
- **Authentication Method:** Select the authentication method as key-based or password based.
  - For key based enter the public key.
  - For password based enter the password.



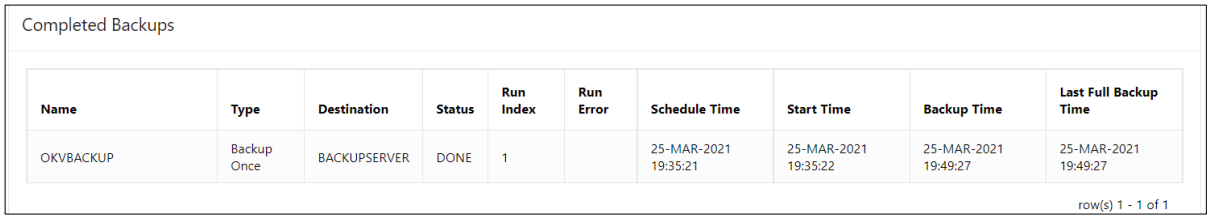
7. Click **Save**. Oracle Key Vault validates the destination. If the validation fails, the destination is not created.

> **NOTE:** You can edit these settings at any time except when restoring from a backup.

8. After the destination is created, click **System Backup→Backup**.
9. Enter the following information for the backup:
   - **Name:** Enter a name to identify the backup.
   - **Start Time:** Select a time for the backup to start. If you want to start it now, select **Now**.
   - **Destination:** Select a local or remote destination.
   - **Type:** Select **One-Time** or **Periodic**. If **Periodic** is selected, specify the time when the backup will be performed.



10. Click **Schedule**. This will enable you to check the backup status as **ACTIVE, ONGOING, PAUSED** or **DONE**. When the backup is in progress, its status will appear as **ONGOING**. Once the backup is completed its status will appear as **DONE**.



11. You can verify the backup files on backup destination.

```
[root@localhost ~]# ls /okv/backup/
okvbackup_onetime.mgr  okvbackup_onetime_onetime_20210325140732_hsm  okvinit.bkp
```

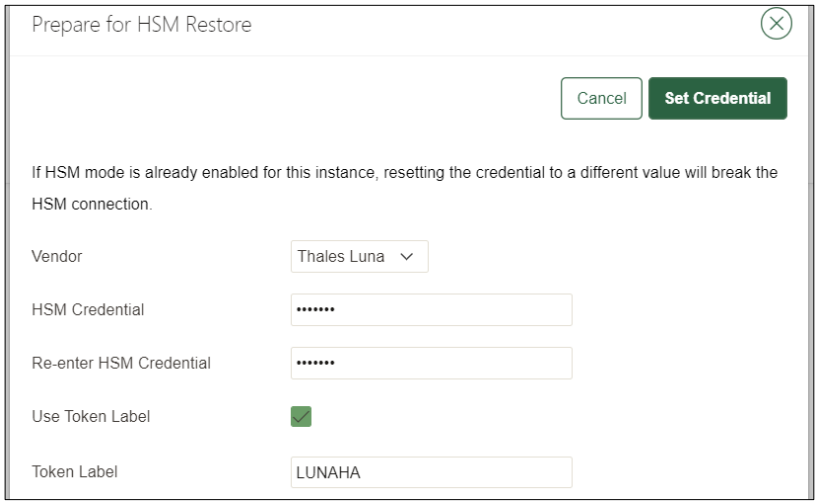
Restore Oracle Key Vault in HSM mode

> **NOTE:** Only backups taken in HSM mode can be restored to an HSM-enabled Oracle Key Vault. Before restoring a backup, you must ensure that the system can access both the HSM and Root of Trust (RoT) used to take the backup. To restore a backup, you must have installed the Luna Client Application on the Oracle Key Vault server and register the partition that was used at the time of backup prior to this procedure.

1. Log in to the Oracle Key Vault management console as a user with System Administrative privileges.
2. For Oracle Key Vault v21.1 or above, click **Settings**. Under **Network Services** click on **HSM**.
3. For Oracle Key Vault v18.5 or below in the left sidebar, click **Hardware Security Module**.
4. The **Status** appears as disabled. Click **Set Credential**. The **Prepare for HSM Restore** dialog appears.
5. Click the **Vendor** drop-down menu and select **Thales Luna**.

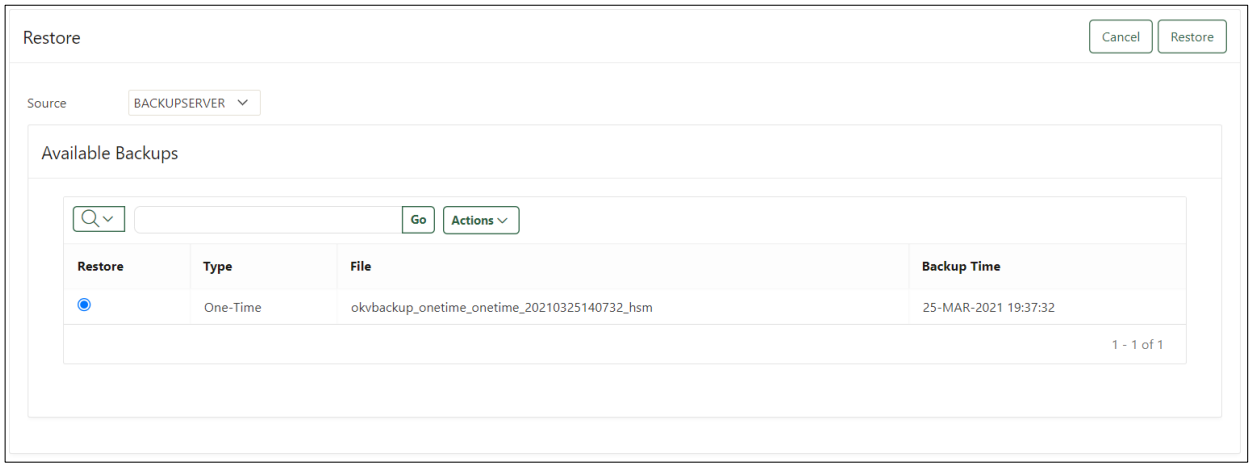
> **NOTE:** In Oracle Key Vault 18.4 or lower, open the Vendor drop-down menu and select Safenet.

6. Enter the partition password in the **HSM Credential** field. Select **Use Token Label** and enter the **Token Label**. Click **Set Credential**.



> **NOTE:** Earlier versions of Oracle Key Vault do not facilitate to select Token Label. Using Token Label you can choose any token if multiple tokens are registered.

7. For Oracle Key Vault v21.1 or above, click **Settings** from the left sidebar and select **Backup and Restore** from **System Configuration**.
8. For Oracle Key Vault v18.5 or below, click **System Backup** from the left sidebar.
9. Click **Restore**. Select the **Source** where the backup files are stored. It will list all the backups available on the source. Select the backup that you want to restore.



10. Click **Restore**.
11. Now enter the **Recovery Passphrase** that was set during the Post Installation Step of Oracle Key Vault and click **Restore**. The restore process will start. You will see the **Status** as **ONGOING**.

> **NOTE:** During the Restore process, the Oracle Key Vault management console may not work. Avoid changing any configuration until the restore is completed.

The system will be restored from the backup and then restarted. The system will be available after the completion of restore process.

Enable Luna HSM in OKV Multi-Master Cluster

You can configure Luna HSM in a multi-master cluster with a single node or multiple nodes using one of the following methods.

> **NOTE:** In a multi-master Oracle Key Vault installation, any Key Vault node in the cluster can use any HSM. The nodes in the multi-master cluster will use different TDE wallet passwords and RoT keys and may or may not use different HSM credentials, depending on how you choose to configure each cluster node.

> Configure Luna HSM for a multi-master cluster starting with single node (recommended)

> Configure Luna HSM for a multi-master cluster with multiples nodes

Configure Luna HSM for a multi-master cluster starting with single node (recommended)

Oracle recommends that to use an HSM with a multi-master cluster, you start with a single HSM-enabled node and then add additional HSM-enabled nodes using the node induction process. Here are the steps:

> Convert an existing Oracle Key Vault server into the first node of the cluster

> HSM-enable the first node

> HSM-enable the candidate node before adding it to the cluster

> Add the HSM-enabled candidate node to the cluster using an HSM-enabled (first) controller node

NOTE: If any node in the cluster is already HSM-enabled, you cannot add a new node that is not HSM-enabled. The Add Node to Cluster page on the controller node will require HSM credentials of the controller node.

Convert an existing Oracle Key Vault server into the first node of the cluster

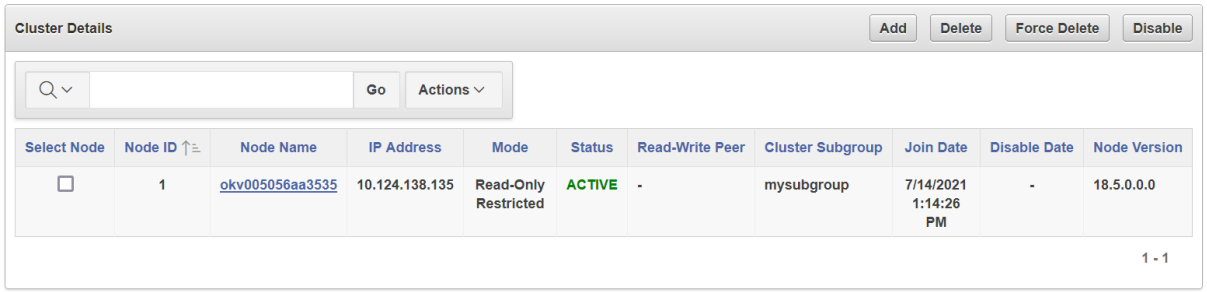
To create a cluster, convert an existing standalone Oracle Key Vault server into the first node of the cluster. This first node is called the initial node or controller node. You can use this node to add one or more nodes to the cluster. The node operates in read-only restricted mode until it is part of a read-write pair. To convert a node into first node, complete the following tasks:

1. Perform a server backup.
2. Log into the Oracle Key Vault management console as a user who has the System Administrator role.
3. If the Oracle Key Vault server was upgraded from a release earlier than Oracle Key Vault release 12.2 (bundle patch 8), then generate and activate (rotate) a new certificate for the node.
4. Select the **Cluster** tab.
5. The Configure as Candidate Node page appears, with the IP address of the current server listed in the **Current Server IP** field.
6. On the **Configure as Candidate Node** page, enter the following information:

   a. **First Node of Cluster**: Select the **Yes** button.
   b. **Node Name**: Enter a unique name for this node. You cannot change this name after it has been accepted in the name resolution process.
   c. **Cluster Name**: Enter a name for this cluster of nodes. You cannot change this name after it has been accepted in the name resolution process.

d. **Cluster Subgroup**: Enter a name for this sub-group of nodes, such as a data center name or a logical group name. You cannot change this name after it has been accepted in the name resolution process.

7. Click the **Convert to Candidate Node** button. After the conversion process is completed, the **Cluster Management** page will appear on screen and you'll be able to operate the node in read-only restricted mode. You can verify this by checking the Cluster Details as shown below.



HSM-enable the first node

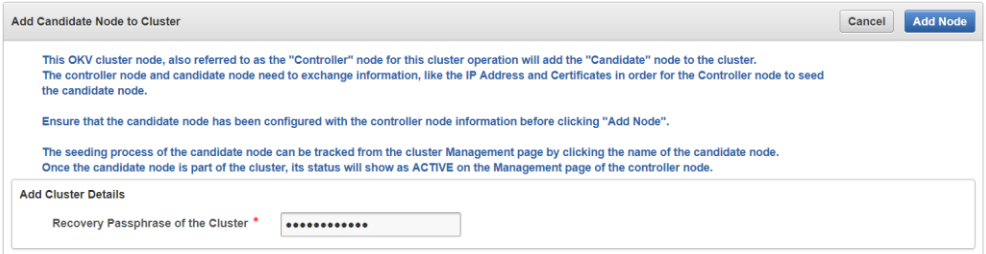
Follow the steps in Configuring Oracle Key Vault to use Thales Luna HSM to enable the HSM on the first node.

HSM-enable the candidate node before adding it to the cluster

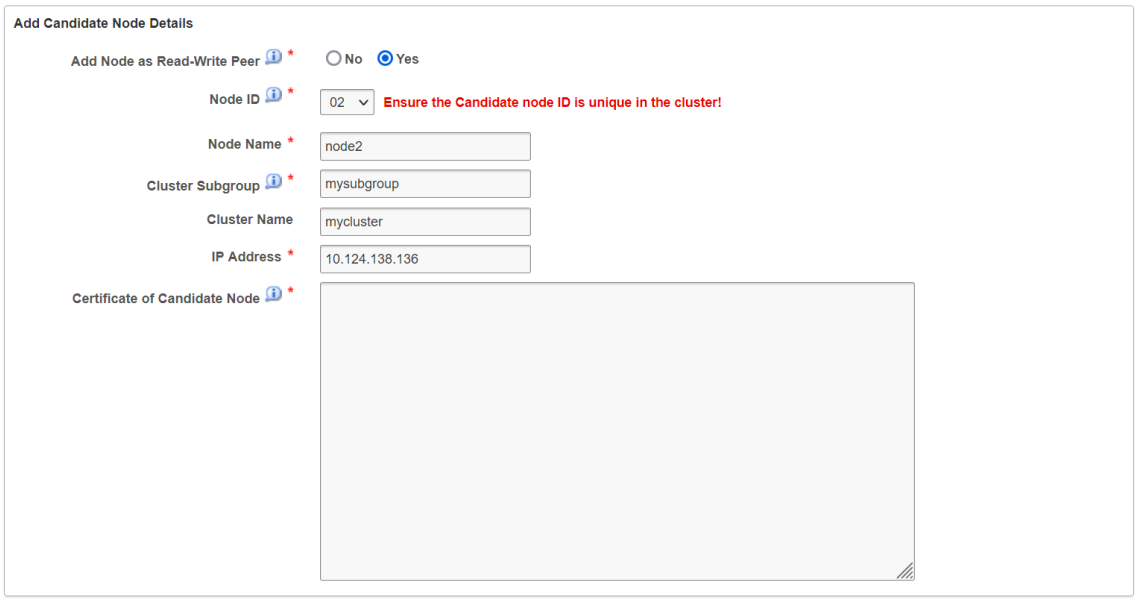
Refer to Configuring Oracle Key Vault to use Thales Luna HSM to enable HSM on candidate node.

Add the HSM-enabled candidate node to the cluster using an HSM-enabled first (controller) node

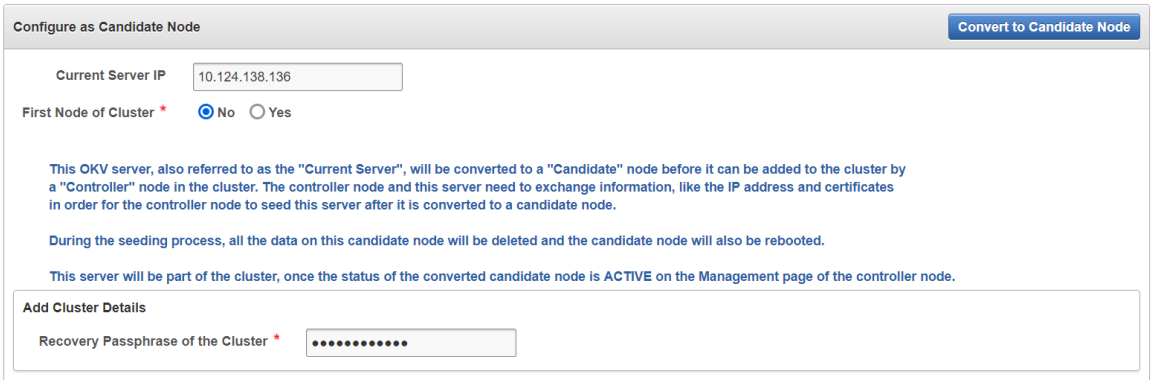
1. Perform a backup of the controller node before continuing.
2. Ensure that the following network requirements are in place:
   a. There is good network connectivity between the servers that host the controller node and the candidate node.
   b. The ports that are required for Oracle Key Vault are open in the network firewall. These ports are described in Network Port Requirements in Oracle Key Vault Documentation.
3. Log into the first (controller) node Oracle Key Vault management console as a user who has the System Administrator role. You can use any existing node, including the first node that does not have a read-write peer to be the controller for this operation. If necessary, add a read-only node first.
4. Select the **Cluster** tab.
5. Click **Add**.
6. In **Recovery Passphrase of the Cluster**, enter the recovery passphrase. This value will be used later when you pair with the candidate node.



7. Select **Yes** for **Add Node as Read-Write Peer**.
8. Enter the following details under **Add Candidate Node Details**. While you enter these details, do not save any of this information or click the **Add Node** button until you reach Step 9.
   a. **Node ID**: Select a unique ID for the candidate node. Remember that after you create this ID, you cannot change it.
   b. **Node Name**: Enter a unique name of the candidate node. After you create this name, you cannot change it.
   c. **Cluster subgroup**: Enter the sub-group name for the candidate node. You can provide an existing subgroup name. If you provide a subgroup name that does not exist, it will be created. Remember that you cannot change the subgroup of this node after the node joins the cluster.
   d. **IP Address**: Enter the IP address of the candidate node.



9. In a new browser window, log into the Oracle Key Vault management console of the candidate node as a user who has the System Administrator role.
10. Select the **Cluster** tab. The Configure as Cluster Candidate page is displayed.
11. For **First Node of Cluster**, select **No**.
12. For **Recovery Passphrase of the Cluster**, enter the recovery passphrase of the cluster that you created earlier for the controller node.



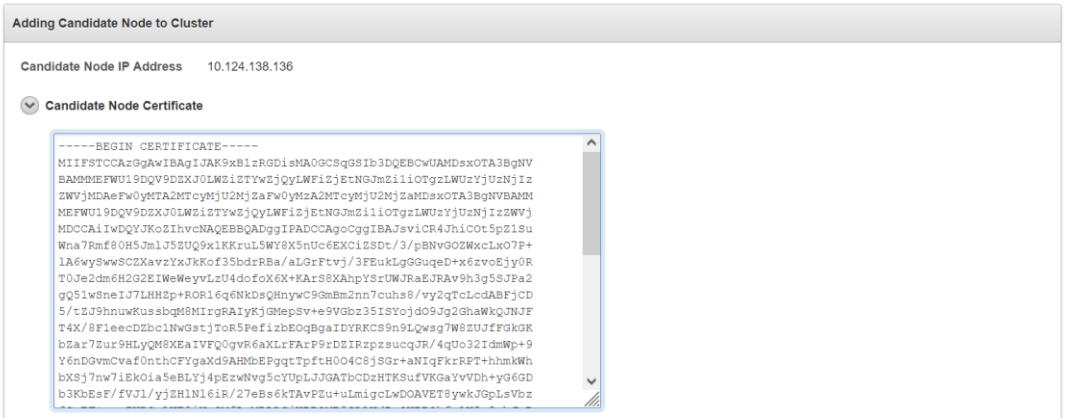
13. For **IP Address**, enter the IP address of the controller node.
14. In the browser window for the controller node, scroll to the bottom of the screen. Select and copy the entire node certificate.

15. In the browser window for the candidate node, paste the copied certificate from the controller node into the **Certificate of the Controller Node** field.

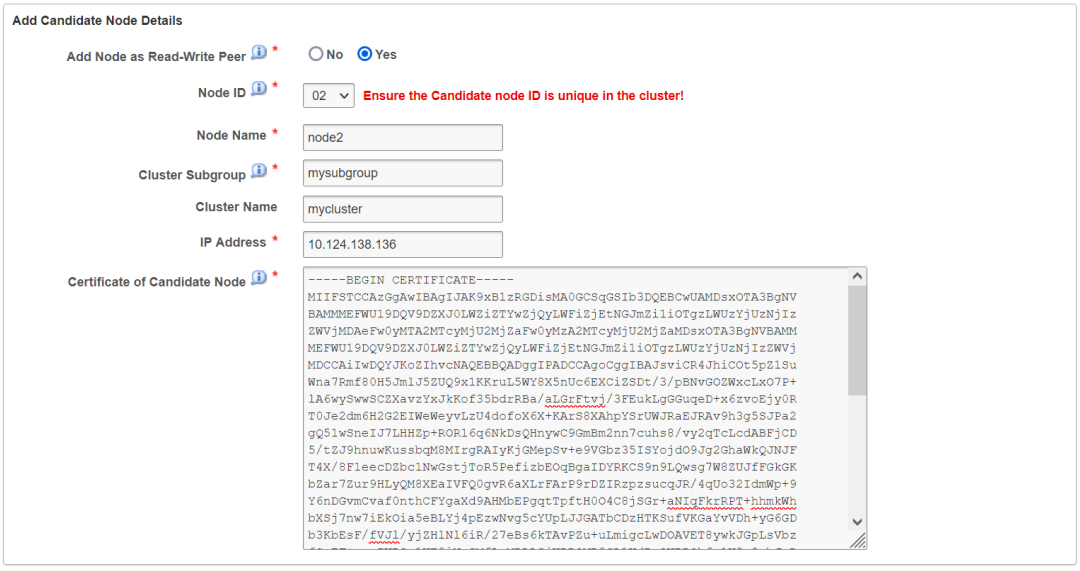
> **NOTE:** Check the recovery passphrase, IP address, and the pasted in certificate very carefully to ensure that you copied it correctly. If there is an error after you click Convert to Candidate Node, you will need to reinstall Oracle Key Vault.

16. Click **Convert to Candidate Node**. After the conversion is completed, the screen gets refreshed and displays the certificate of the candidate node. The Adding Candidate Node to Cluster page is displayed. This can take several minutes.

17. Select and copy the entire candidate node certificate.



18. In the browser window of the controller node, paste the copied certificate from the candidate node into the **Certificate of Candidate Node** box.

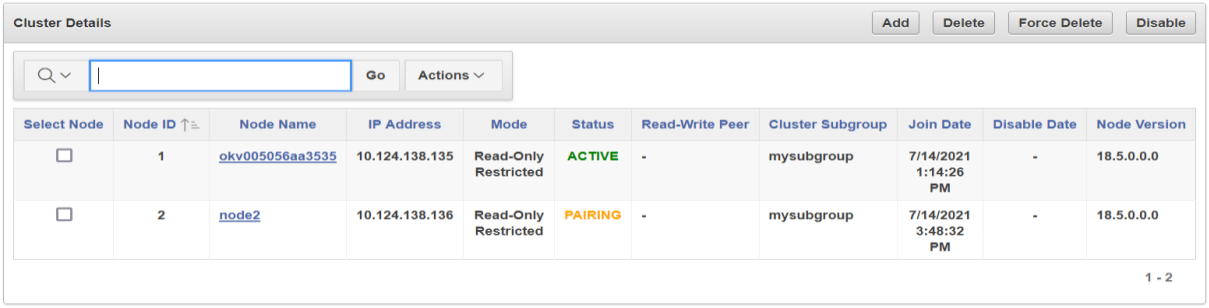


19. Add **HSM Credential** that is partition password.

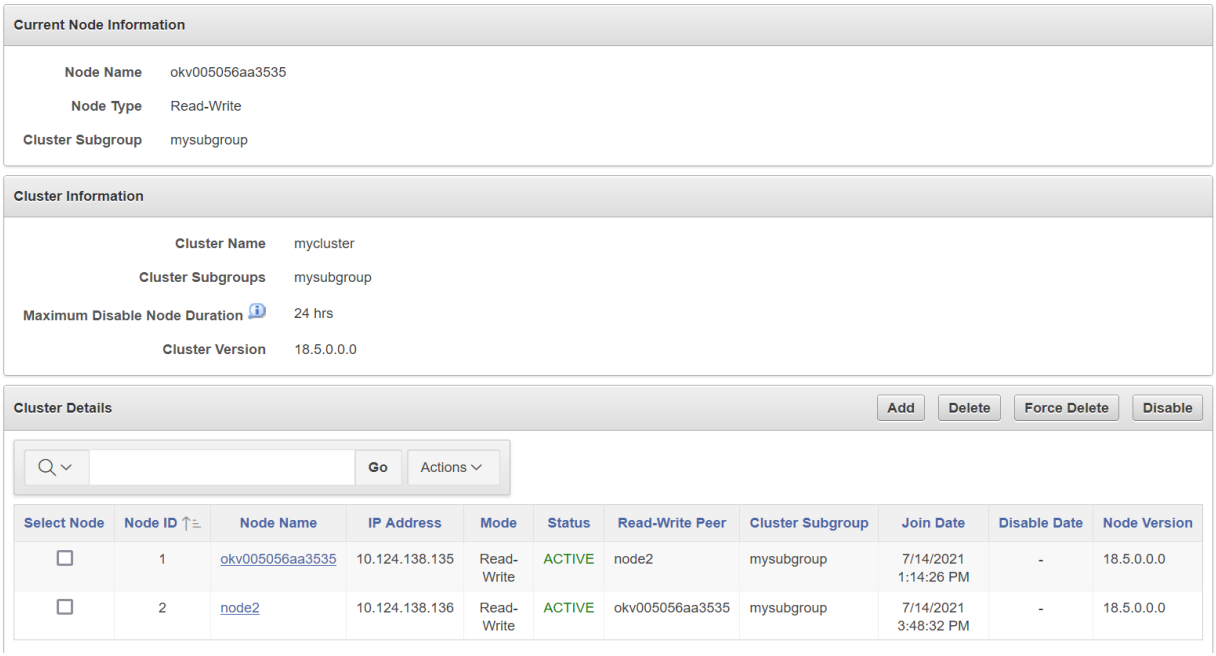
20. Click **Add Node**.

21. Click **OK** to confirm in the confirmation dialog box. This process will take an hour or more, depending on the speed of your server, quality of network, and volume of data in the cluster. During this period,

the network management interface of the Oracle Key Vault will be restarted and you might momentarily get a Server Error 500 on the controller node. On the candidate node, errors may also appear, such as Bad Gateway. The candidate node will restart as part of the induction process. This is normal. During the pairing process, the status of the candidate node will appear as **PAIRING** on all cluster nodes.



22. Verify that after pairing is completed, the status of both the nodes is **ACTIVE** with Read-Write Peer mode.



Configure Luna HSM for a multi-master cluster with multiples nodes

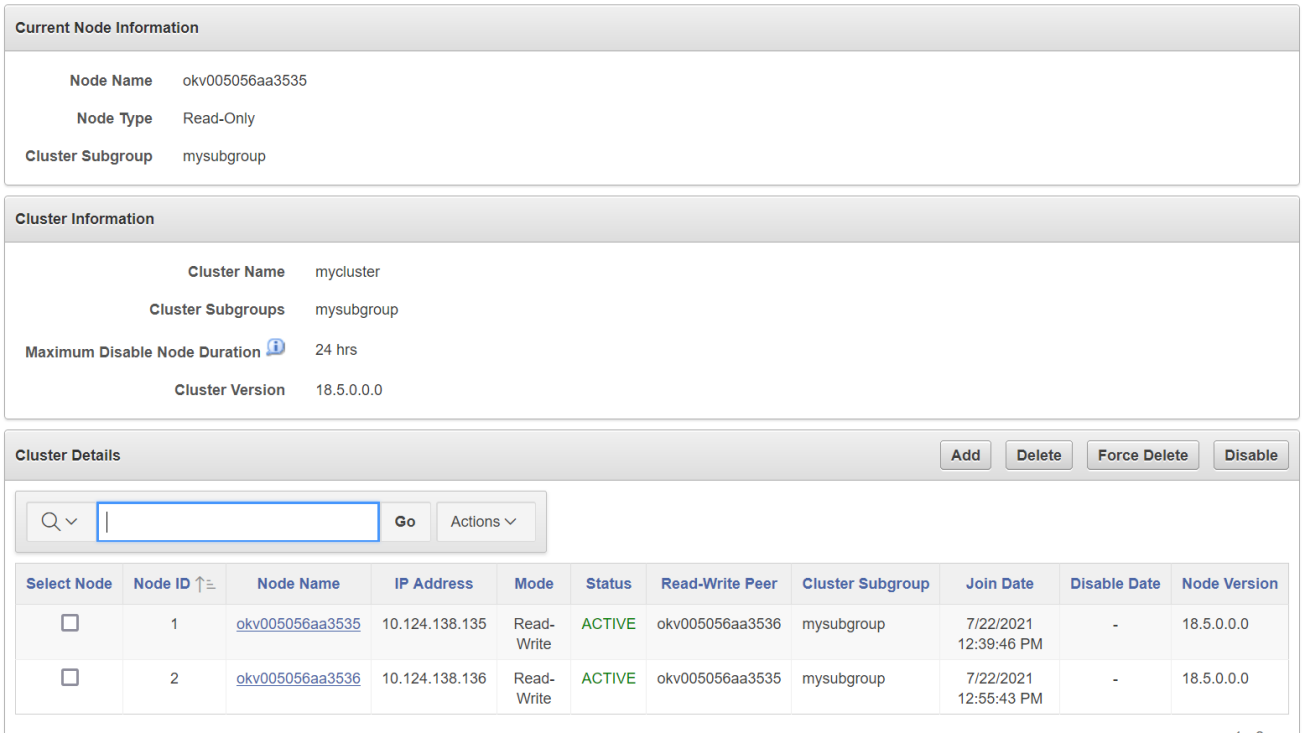
You can configure HSM for a multi-master Cluster with multiple nodes by completing these tasks:

> HSM-enable the first node

> Create and copy the bundle after HSM-enabling the first node

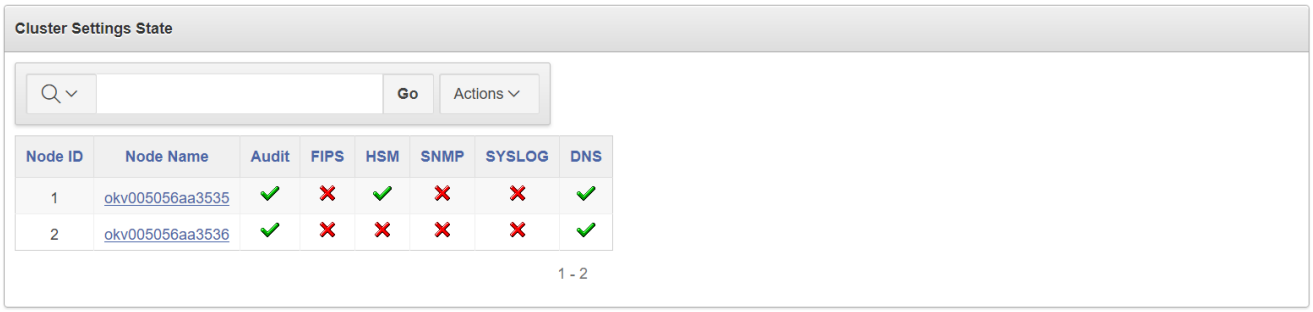
> Configure the remaining nodes

Before proceeding to the main steps, it is assumed that you have multi-master cluster setup ready with multiples nodes, as shown below:



HSM-enable the first node

Follow the steps in Configuring Oracle Key Vault to use Thales Luna HSM to enable HSM on the first node. After the HSM is enabled, you can see its status in the Cluster Settings State page.

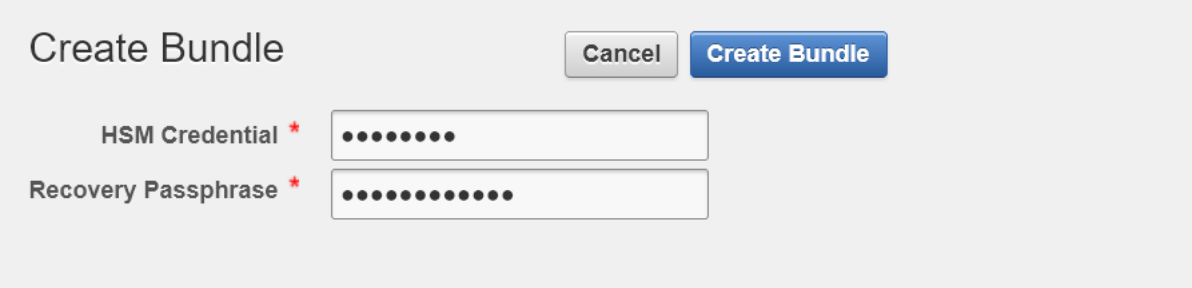


Create and copy the bundle after HSM-enabling the first node

After HSM-enabling the first node in the multi-master cluster, you must create a bundle and copy it to the other nodes in the cluster.

1. Log in to the Oracle Key Vault management console as a user who has the System Administrator role.
2. Click the **System** tab.
3. On the left side of the System page, click **Hardware Secure Module**.
4. On the HSM-enabled node, click **Create Bundle** on the HSM page.

5. In the Create Bundle dialog box, do the following:
   a. In the **HSM Credential** field, enter the HSM credentials.
   b. In the **Recovery Passphrase** field, enter the recovery passphrase.
   c. Click the **Create Bundle** button.



6. Log in to the HSM-enabled node through SSH as user support.

```
# ssh support@hsm_enabled_node
```

7. Switch to the root user.

```
# su root
```

8. To copy the bundle to the /usr/local/okv/hsm location on each of the other nodes using the IP address, use SCP.

```
# scp /usr/local/okv/hsm/hsmbundle support@ip_address:/tmp
```

Configure the remaining nodes

After you configure the first node, you are ready to install the bundle on the remaining nodes. Complete this procedure as soon as possible after you have HSM-enabled the first node and copied the bundle to all other nodes.

1. Log in to each node in the cluster using the IP address (except the original HSM-enabled node):.

```
# ssh support@ip_address
```

2. On each node, switch to the root user: `# su root`
3. Copy the /tmp/hsmbundle file to /usr/local/okv/hsm/

   ```
   # cp /tmp/hsmbundle /usr/local/okv/hsm/
   ```

4. Change the ownership of the hsmbundle file to user oracle and group oinstall.

   ```
   # chown oracle:oinstall /usr/local/okv/hsm/hsmbundle
   ```

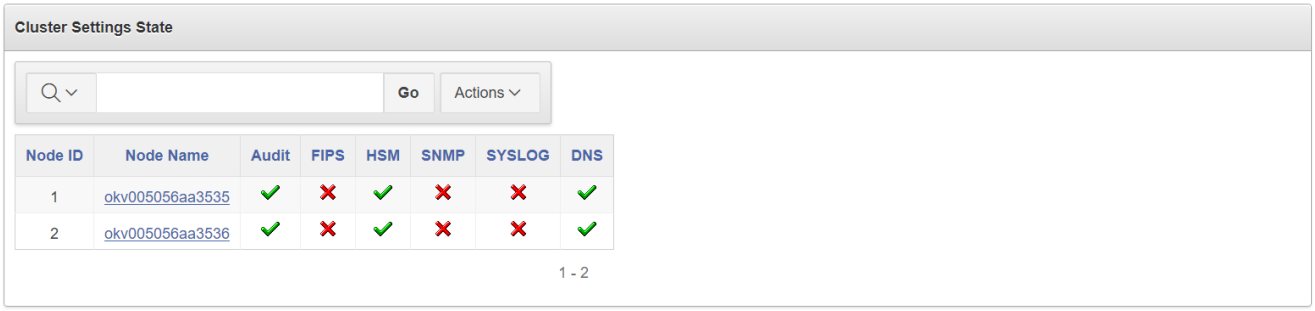
   a. On each node, except the original HSM-enabled node, click **Apply Bundle** on the **HSM** page, and then follow these steps:

   b. In the **Recovery Passphrase** field, enter the recovery passphrase.

   c. Click the **Apply Bundle** button.

   > **Note:** You must apply the bundle immediately on all nodes before you reverse-migrate the original HSM-enabled node.

5. Proceed to HSM-enable each of the remaining nodes in the cluster, using the steps in Configuring Oracle Key Vault to use Thales Luna HSM.
6. Verify that the HSM is enabled on every node in the cluster in Cluster Settings State.



7. After you have HSM-enabled all nodes and verified the replication between all nodes, remove the hsmbundle file from all the nodes.

This completes the Luna HSM integration with Multi-Master OKV Cluster.

Contacting customer support

If you encounter a problem during this integration, contact your supplier or Thales Customer Support. Thales Customer Support operates 24 hours a day, 7 days a week. Your level of access to this service is governed by the support plan arrangements made between Thales and your organization. Please consult this support plan for further information about your entitlements, including the hours when telephone support is available to you.

Customer support portal

The Customer Support Portal, at https://supportportal.thalesgroup.com, is a database where you can find solutions for most common problems. The Customer Support Portal is a comprehensive, fully searchable repository of support resources, including software and firmware downloads, release notes listing known problems and workarounds, a knowledge base, FAQs, product documentation, technical notes, and more. You can also use the portal to create and manage support cases.

> **NOTE:** You require an account to access the Customer Support Portal. To create a new account, go to the portal and click on the **REGISTER** link.

Telephone support

If you have an urgent problem, or cannot access the Customer Support Portal, you can contact Thales Customer Support by telephone at +1 410-931-7520. Additional local telephone support numbers are listed on the support portal.

Email support

You can also contact technical support by email at technical.support.DIS@thalesgroup.com.