THALES

Thales Luna Network HSM 7

CLUSTER ADMINISTRATION GUIDE

Document Information

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Regulatory Compliance

This product complies with the following regulatory regulations. To ensure compliancy, ensure that you install the products as specified in the installation instructions and use only Thales-supplied or approved accessories.

USA, FCC

This equipment has been tested and found to comply with the limits for a “Class B” digital device, pursuant to part 15 of the FCC rules.

Canada

This class B digital apparatus meets all requirements of the Canadian interference-causing equipment regulations.

Europe

This product is in conformity with the protection requirements of EC Council Directive 2014/30/EU. This product satisfies the CLASS B limits of EN55032.

CONTENTS

PREFACE: About the Cluster Administration Guide

This document describes the setup and administrative procedures required to use clusters and keyrings on your Luna Network HSM 7.

> **NOTE** Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

The preface includes the following information about this document:

For information regarding the document status and revision history, see "Document Information" on page 2.

Customer Release Notes

The Customer Release Notes (CRN) provide important information about specific releases. Read the CRN to fully understand the capabilities, limitations, and known issues for each release. You can view the latest version of the CRN at www.thalesdocs.com.

Audience

This document is intended for personnel responsible for maintaining your organization's security infrastructure. This includes Luna HSM users and security officers, key manager administrators, and network administrators.

All products manufactured and distributed by Thales are designed to be installed, operated, and maintained by personnel who have the knowledge, training, and qualifications required to safely perform the tasks assigned to them. The information, processes, and procedures contained in this document are intended for use by trained and qualified personnel only.

It is assumed that the users of this document are proficient with security concepts.

Document Conventions

This document uses standard conventions for describing the user interface and for alerting you to important information.

Notes

Notes are used to alert you to important or helpful information. They use the following format:

> **NOTE** Take note. Contains important or helpful information.

Cautions

Cautions are used to alert you to important information that may help prevent unexpected results or data loss. They use the following format:

> **CAUTION!** Exercise caution. Contains important information that may help prevent unexpected results or data loss.

Warnings

Warnings are used to alert you to the potential for catastrophic data loss or personal injury. They use the following format:

> ****WARNING** Be extremely careful and obey all safety and security measures. In this situation you might do something that could result in catastrophic data loss or personal injury.**

Command syntax and typeface conventions

Format	Convention
bold	The bold attribute is used to indicate the following: > Command-line commands and options (Type **dir /p**.) > Button names (Click **Save As**.) > Check box and radio button names (Select the **Print Duplex** check box.) > Dialog box titles (On the **Protect Document** dialog box, click **Yes**.) > Field names (**User Name**: Enter the name of the user.) > Menu names (On the **File** menu, click **Save**.) (Click **Menu** > **Go To** > **Folders**.) > User input (In the **Date** box, type **April 1**.)
italics	In type, the italic attribute is used for emphasis or to indicate a related document. (See the *Installation Guide* for more information.)
<variable>	In command descriptions, angle brackets represent variables. You must substitute a value for command line arguments that are enclosed in angle brackets.
[**optional**] [<optional>]	Represent optional **keywords** or <variables> in a command line description. Optionally enter the keyword or <variable> that is enclosed in square brackets, if it is necessary or desirable to complete the task.
{**a**|**b**|**c**} {<a>|<b>|<c>}	Represent required alternate **keywords** or <variables> in a command line description. You must choose one command line argument enclosed within the braces. Choices are separated by vertical (OR) bars.
[**a**|**b**|**c**] [<a>|<b>|<c>]	Represent optional alternate keywords or variables in a command line description. Choose one command line argument enclosed within the braces, if desired. Choices are separated by vertical (OR) bars.

Support Contacts

If you encounter a problem while installing, registering, or operating this product, please refer to the documentation before contacting support. If you cannot resolve the issue, contact your supplier or Thales Customer Support. Thales Customer Support operates 24 hours a day, 7 days a week. Your level of access is governed by the support plan negotiated between Thales and your organization. Please consult this plan for details regarding 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 where you can find solutions for most common problems and create and manage support cases. It offers a comprehensive, fully searchable database 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.

> **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

The support portal also lists telephone numbers for voice contact (Contact Us).

CHAPTER 1: Clusters

Luna Network HSM 7 now allows you to store your cryptographic objects in an encrypted *cluster* within the appliance memory. This process uses Scalable Key Storage (SKS) to encrypt the cluster and the SMK is shared with all member HSMs. The cluster contains *keyrings*, which are analogous to application partitions and can be accessed by a client in much the same way, by connecting to any member appliance. Keys are retrieved from the cluster, decrypted within the secure confines of the HSM, and used by the HSM for cryptographic operations. This configuration allows you to store many more keys than you can normally store within HSM partitions. The management of backup and restore operations is greatly simplified; the HSM administrator can back up the full content of a cluster, at scheduled intervals or on demand.

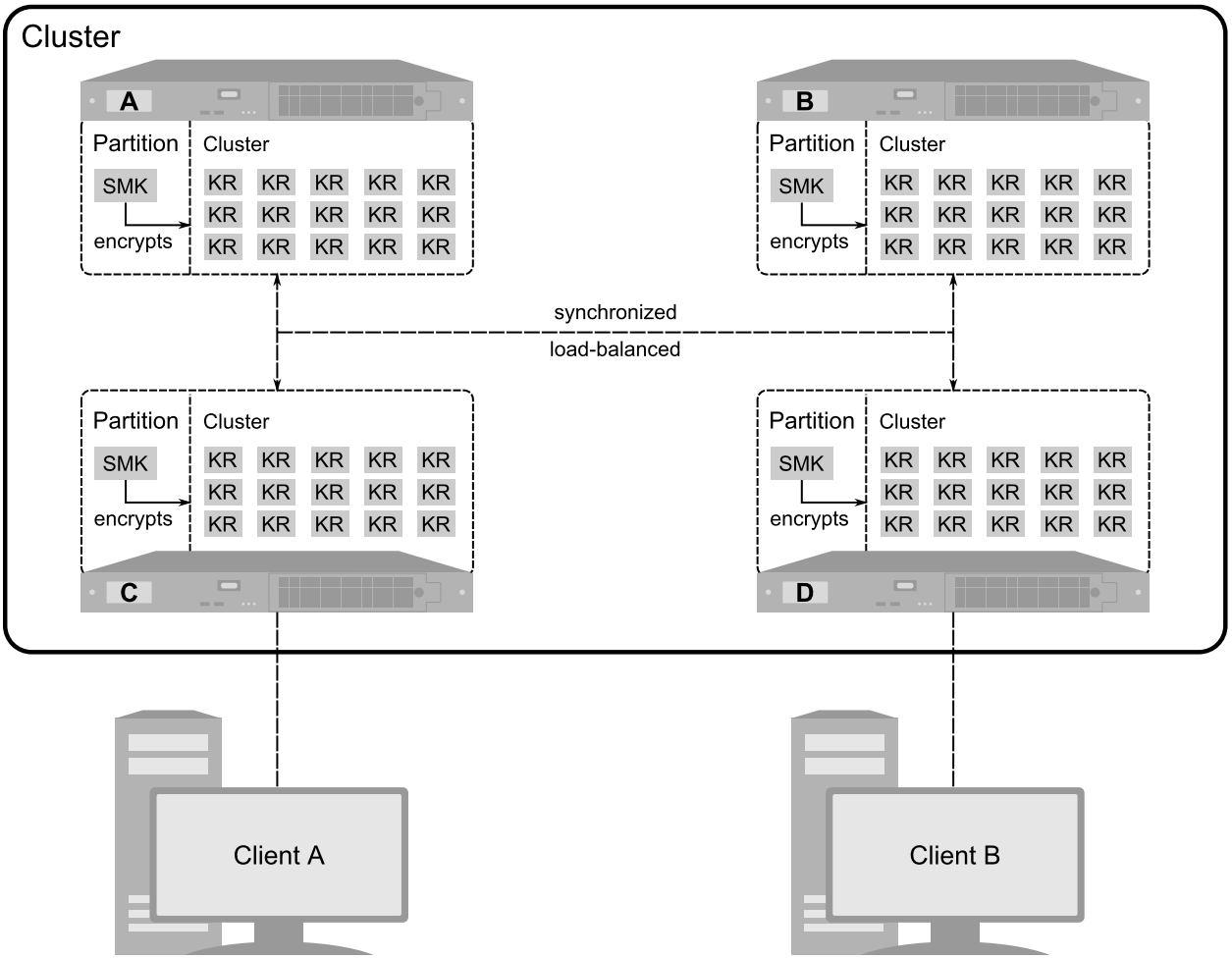
A cluster can consist of one Luna Network HSM 7 member appliance, or multiple appliances that share the contents of the cluster. Adding multiple members to a cluster improves performance, and provides redundancy and failover for your client applications. Thales recommends a maximum of 4 members per cluster.

Up to 3500 keyrings can be created on the cluster, and each keyring can contain up to 256 objects. Each Luna HSM Client can manage up to 3500 keyrings, which can be spread across multiple clusters.

With the latest release, Thales is pleased to announce that "Clusters" above are fully supported for new production deployments, designed to reduce operation cost and maximize the return on investment of a fleet of HSMs. This release does not provide a migration path from standard Luna partitions or Luna Cloud HSM services to keyrings. Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

> **NOTE** Unlike the PSO and CO roles on standard Luna partitions, the KRSO and KRCO roles on each keyring are intended to be held by the same individual, and use the same password. When the password for one role is changed, the change is applied to the other role as well. Consider this distinction when planning your cluster deployment and setting your KRSO passwords.

> ***CAUTION!*** ***DO NOT INSTALL THE CLUSTER PACKAGE ON A LUNA NETWORK HSM WITH PARTITIONS ALREADY IN PRODUCTION***
>
> When the **lnh_cluster** package is installed, access to any existing partitions on the HSM is disabled, and this can only be reversed by re-imaging the Luna Network HSM 7 appliance (see Re-Imaging the Appliance to Factory Baseline). Re-imaging is a destructive action; all roles, partitions, and keys are destroyed. The Luna Network HSM 7 must be completely reconfigured; all partitions must be recreated and their contents restored from backup. In particular, do not attempt to configure clustering on a Luna Network HSM 7 that already has V1 partitions created; either delete these partitions or re-image the appliance before configuring a cluster.



This section will guide you through key concepts and procedures required to set up, manage, and use your Luna Network HSM 7 cluster.

The SKS Master Key

Objects on the cluster are encrypted by a master key, which is created and stored on a V1 application partition on the primary cluster member. New members that join the cluster import the same SMK to a V1 partition on their local HSM. This allows each member to have read-write access to objects on the shared cluster. Refer to Scalable Key Storage (SKS) for more information.

Client-Cluster Connections

Each Luna HSM Client that runs applications using objects on the cluster directs its traffic to a specified cluster member. The **LNHClientRegistration** script is provided with the client software for this purpose. The member specified when running the client registration script acts as the first point of contact between that client and the cluster; all client application requests are directed to that member, and then load-balanced to other cluster members.

Refer to "Cluster-Client Connections" on page 34 for guidelines on using the **LNHClientRegistration** script.

Synchronization and Load-Balancing

Keyrings and their contents are synchronized across all members of the cluster, so any member can be queried by client applications for cryptographic operations. Appliance user accounts are also synchronized via the cluster, so users with **admin**, **operator**, and **monitor** privileges can log in to any member. In a cluster with two or more members, the users/roles configuration stored in the cluster are taken as the authority -- if an appliance with custom users/roles joins the cluster, they are overwritten by the users/roles stored in the cluster. This ensures that all cluster members have the same authorized users, and that those users can log in to any individual cluster member.

Client operations are load-balanced across the cluster members to optimize performance and availability. Load-balancing can be customized by moving members between "Affinity Groups" on the next page as described below.

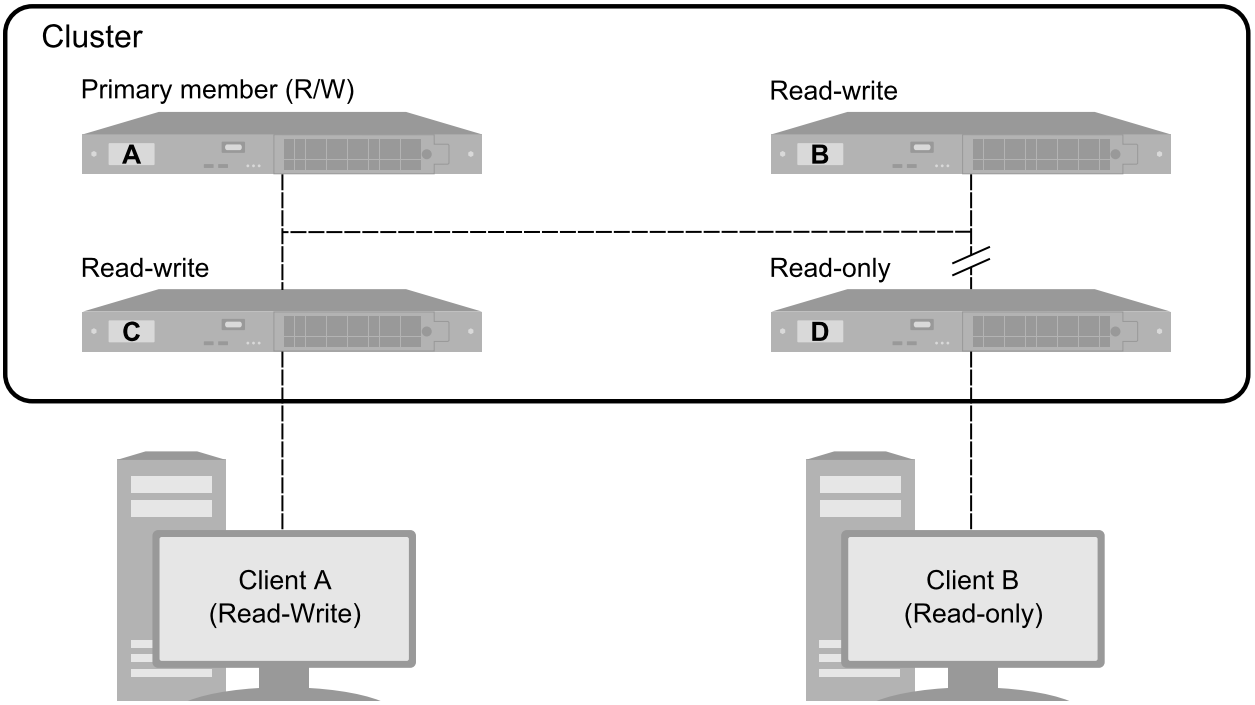
The Primary Member

The Luna Network HSM 7 appliance where the cluster is created becomes the *primary* cluster member. The primary member always has read-write privileges to the cluster; other members have read-write privileges as long as they maintain a network connection to the primary member. If a member's connection to the primary member is disrupted, that member becomes read-only until the connection is re-established. New and existing client sessions become read-only. This applies to connections between the primary and the other members, and is not affected by the client; if a member becomes read-only, the client will not fail over to another member for operations requiring write privileges; these operations will fail. This is necessary to prevent objects stored on the cluster from becoming de-synchronized between members.

You can manually promote a member to primary at any time, as long as that member has read-write privileges at the time of promotion. If the primary cluster member loses connectivity to the cluster, all other members become read-only until it is reconnected. If the primary member is unrecoverable, you must manually remove it from the cluster, at which time another member will automatically be promoted to primary, and the cluster members regain read-write privileges.

See "Promoting a Member to Primary" on page 29.

In the example below, member D has lost connectivity to the primary cluster member. Thus, Client B can perform only operations that do not require write privileges, until member D re-establishes a connection to the primary member, or Client B's traffic is directed to a different member.

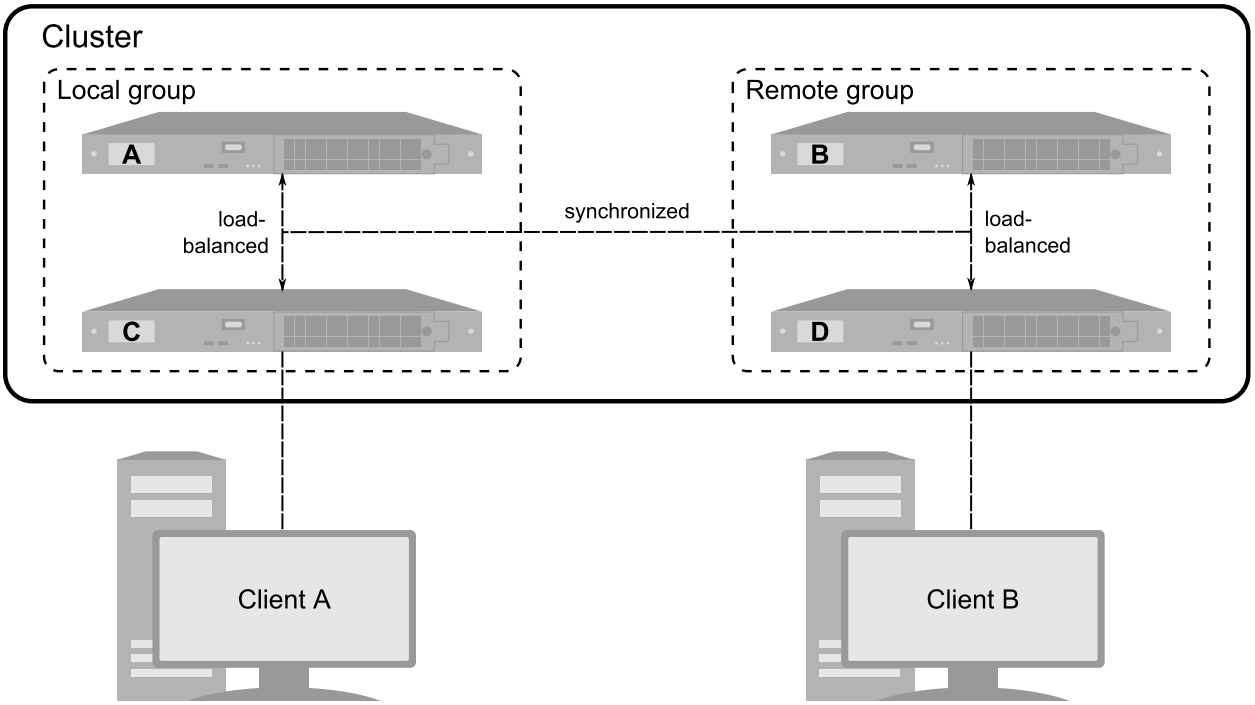


Affinity Groups

Luna Network HSM 7s within a cluster can be added to an affinity group. Operations from a connected client application are load-balanced between members of the same group only. This allows you to use the other members, which can be at a remote location with greater latency, as backup or standby members for a specific client. If all members of a client's preferred group are unavailable, operations then fail over to other members of the cluster. The state of keyrings and objects stored on them is always synchronized across all members of the cluster, regardless of group. You can create up to 64 affinity groups in a cluster.

New members are added to the **local** group by default and can be moved to another group (see "Moving a Member to a Different Affinity Group" on page 28).

In the example below, the groups are configured so that Client A sends operation requests to cluster member C, (which are load-balanced between members A and C) and Client B sends operation requests to cluster member D (which are load-balanced between members B and D). Each group acts as a standby group for the other.



Keyring Roles and Authentication

Each keyring on a cluster has two roles that are analogous to the Partition Security Officer and Crypto Officer roles on a standard Luna partition. They are referred to here as:

- **Keyring Security Officer (KRSO)**: initially set by the Partition Security Officer for the partition that created the cluster
- **Keyring Crypto Officer (KRCO)**: performs cryptographic operations on the keyring

Unlike the PSO and CO roles on standard Luna partitions, the KRSO and KRCO roles on each keyring are intended to be held by the same individual, and use the same password. When the password for one role is changed, the change is applied to the other role as well. Consider this distinction when planning your cluster deployment and setting your KRSO passwords.

Separation is always enforced between the keyring roles and the cluster security officer (PO of the partition where the cluster's SMK is stored).

Keyring Object Attributes

Keyrings can be used much like standard Luna partitions to create and store cryptographic objects, and perform operations using those objects. The following attributes may be set on keyring objects:

- CKA_LABEL
- CKA_ECDSA_PARAMS
- CKA_EC_POINT
- CKA_TOKEN
- CKA_VALUE
- CKA_KEY_TYPE

- CKA_CLASS
- CKA_UNWRAP
- CKA_SIGN
- CKA_DECRYPT
- CKA_ID
- CKA_MODULUS
- CKA_WRAP
- CKA_PUBLIC_EXPONENT

Cluster Backup/Restore

The entire contents of the cluster can be backed up to the Luna Network HSM 7 appliance in an encrypted file, accessible to the **admin** user. You can perform backups on demand, or schedule periodic backups and determine how many to store before the oldest ones are overwritten. You can restore the entire cluster from a backup at any time. See "Cluster Backup and Restore" on page 41 for procedures.

CHAPTER 2: Installing and Configuring the Cluster Package

The following procedures will allow you to install the **lnh_cluster** secure package on the Luna Network HSM 7, and configure the appliance for a cluster, using "REST API" below calls or "LunaSH" on page 19. This procedure must be completed whether you are creating a new cluster (see "Creating a Cluster" on page 23), or joining an existing cluster (see "Adding a New Member to an Existing Cluster" on page 25).

> **NOTE** Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

REST API

Prerequisites

> The Luna Network HSM 7 must be configured and accessible over the network. All members of a cluster must be able to communicate bi-directionally with all other members. Refer to Configuring IP and Network Parameters.

> If you are setting up a cluster on a multifactor quorum-authenticated HSM, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

> If you plan to use REST API to work with clusters, set up the **webserver** service so that the appliance can accept calls from your web application.

Refer to Webserver Setup.

After configuring the **webserver** service, you must synchronize the HSM time with the time on the appliance.

lunash:> **hsm time sync**

> The Luna Network HSM 7 must be initialized.

PUT /api/lunasa/hsms/{hsmid}

> Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

Refer to:

- Updating the Luna Network HSM 7 Appliance Software
- Updating the Luna HSM Firmware

> The Luna Network HSM 7 and any clients must have NTP configured, or have their system clocks synchronized manually. Clocks must be synchronized before starting the cluster service:

- **Using NTP** (actionid: **synchronize**)**:** POST /api/lunasa/ntp/actions/{actionid}

- **Manually:** PUT /api/lunasa/time

> **CAUTION!** If the system clock is adjusted after the cluster certificate is created, the certificates might not be valid due to date/time. For example, if the certificate is generated while the system clock is ahead by a few minutes, and the clock is then corrected, the certificate will not be valid until the clock catches up to the time it was set to when the cert was created. If the current system time does not fall within the certificate's range of validity, the **cluster** service fails to start.

To configure the appliance for clustering

1. Open a session to the Luna REST API on the Luna Network HSM 7.

   POST /auth/session

2. Create a new application partition or provision an existing partition for cluster and keyring creation.

   a. Create a new application partition, specifying a V1 partition.

   > **CAUTION!** Using a V0 partition to create a cluster can cause undesired behavior and require you to factory reset the **cluster** service and recreate the partition.
   >
   > Only one V1 partition can exist on an appliance configured for clustering; do not create more than one V1 partition.

   POST /api/lunasa/hsms/{hsmid}/partitions

   b. Initialize the partition and the Partition Security Officer (PO) role.

   > **NOTE** The partition that will hold the SKS Master Key (SMK) on each cluster member must use the same cloning domain. If you are configuring this appliance to join an existing cluster, ensure that you use the same domain string or PED key that was used to initialize the partition on the primary member.

   PUT /api/lunasa/hsms/{hsmid}/partitions/{partitionid}

   c. Log in with the new Partition SO credential, and set **partition policy 40:** Require Per-Key Authorization Data to **0**. Confirm the policy change task (actionid: **start**).

      i. POST /api/lunasa/hsms/{hsmid}/partitions/{partitionid}/login

      ii. PUT /api/lunasa/hsms/{hsmid}/partitions/{partitionid}/policies/{policyid}

      iii. POST /tasks/{taskid}/actions/{actionid}

   > **CAUTION!** Changing partition policies after you have created and are using clusters can cause unwanted behavior. Ensure that you have configured all your desired policy settings before you continue. This includes policies for Activation on Multifactor Quorum-Authenticated Partitions.

   d. Initialize the Crypto Officer (CO) role (roleid: **co**).

      i. PUT /api/lunasa/hsms/{hsmid}/partitions/{partitionid}/roles/{roleid}

> **NOTE** If **HSM policy 21:** Force user PIN change after set/reset is enabled (this is the default setting), the CO must change the password/PED key from its initial value before any other actions are permitted.

ii. PATCH /api/lunasa/hsms/{hsmid}/partitions/{partitionid}/roles/{roleid}

3. Install the **lnh_cluster** secure package on the Luna Network HSM 7.
   a. Transfer the secure package update file to the Luna Network HSM 7 using **pscp** or **scp**.

      pscp <path>**/lnh_cluster-1.0.#-###.spkg admin@**<appliance_host/IP>**:**

   b. Log in as HSM SO.

      POST /api/lunasa/hsms/{hsmid}/login

   c. [Optional] Verify that the secure package file is present on the Luna Network HSM 7.

      GET /users/{userid}/files

   d. [Optional] Verify the package file, specifying the authorization code you received from Thales.

      POST /api/lunasa/packageFiles**?VerifyOnly=true**

      GET /tasks/{taskid}/response

   e. Install the **lnh_cluster** secure package.

      POST /api/lunasa/packageFiles**?VerifyOnly=false**

4. [Optional] Enable the **cluster** service on the appliance (serviceid: **cluster**). Enabling the service means that it will automatically restart in the case of an appliance reboot.

   PATCH /api/lunasa/services/{serviceid}

```
{
  "onBoot": true
}
```

5. Set the IP address to use for the core cluster traffic on this member appliance. This must be the same IP address as one of the appliance's network interfaces.

   > **NOTE** The core IP address cannot be changed later, except after factory reset.

   PUT /api/cluster/config

```
{
  "service": "core",
  "IpAddress": "127.0.0.1"
}
```

6. Start the **cluster** service on the appliance (serviceid: **cluster**, actionid: **start**).

   POST /api/lunasa/services/{serviceid}/actions/{actionid}

   > **NOTE** The **cluster** service cannot be started if a user partition has not yet been created (refer to step 1).

7. Check the status of the **cluster** service (`"onBoot": true` and running). It may take several minutes for the **cluster** service to start, and the next step will fail if it is still starting up. This resource reports `"status": "stopped"` until the **cluster** service startup has finished.

   GET /api/lunasa/services/{serviceid}

8. [Optional] You can also bind the administrative and cryptographic traffic to the cluster to specified network devices, including assigning a port number from a limited range (**admin**: **50075-50079**, **crypto**: **50055-50059**).

   PUT /api/cluster/config

   ```
   {
     "service": "crypto",
     "interface": "eth0",
     "port": 50075
   }
   ```

   > **CAUTION!** In this release, changing the default port used for crypto operations on the cluster (**50052**) can cause communication problems between cluster members. Refer to known issue LUNA-26485.

9. [Optional] Check that the network configuration was set correctly.

   GET /api/cluster/config

You can now create a new cluster on the appliance (see "Creating a Cluster" on page 23) or join a cluster on a different appliance (see "Adding a New Member to an Existing Cluster" on page 25).

LunaSH

Prerequisites

- The Luna Network HSM 7 must be configured and accessible over the network. All members of a cluster must be able to communicate bi-directionally with all other members. Refer to Configuring IP and Network Parameters.
- If you are setting up a cluster on a multifactor quorum-authenticated HSM, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.
- The Luna Network HSM 7 must be initialized (see Initializing the HSM).
- Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

  Refer to:

  - Updating the Luna Network HSM 7 Appliance Software
  - Updating the Luna HSM Firmware
  - Updating the Luna HSM Client Software
- The Luna Network HSM 7 and any clients must have NTP configured, or have their system clocks synchronized manually. Clocks must be synchronized before starting the **cluster** service. Refer to NTP on Luna Network HSM 7 or Setting the System Date and Time.

> **CAUTION!** If the system clock is adjusted after the cluster certificate is created, the certificates might not be valid due to date/time. For example, if the certificate is generated while the system clock is ahead by a few minutes, and the clock is then corrected, the certificate will not be valid until the clock catches up to the time it was set to when the cert was created. If the current system time does not fall within the certificate's range of validity, the **cluster** service fails to start.

To configure a partition for clustering

1. Create a new application partition for cluster and keyring creation.
   a. Create a new application partition in LunaSH, specifying a V1 partition.

   > **CAUTION!** Using a V0 partition to create a cluster can cause undesired behavior and require you to factory reset the **cluster** service and recreate the partition.
   >
   > Only one V1 partition can exist on an appliance configured for clustering; do not create more than one V1 partition.

   Refer to Creating or Deleting an Application Partition.

   b. Initialize the partition and the Partition Security Officer (PO) role in LunaSH, specifying the policy template filename.

   > **NOTE** The partition that will hold the SKS Master Key (SMK) on each cluster member must use the same cloning domain. If you are configuring this appliance to join an existing cluster, ensure that you use the same domain string or PED key that was used to initialize the partition on the primary member.

   Refer to Initializing an Application Partition.

   c. Set **partition policy 40:** Require Per-Key Authorization Data to **0** (OFF).

   Refer to Setting Partition Policies Manually.

   d. Initialize the Crypto Officer (CO) role in LunaSH. If necessary, change the initial CO credential.

   > **NOTE** If **HSM policy 21:** Force user PIN change after set/reset is enabled (this is the default setting), the CO must change the password/PED key from its initial value before any other actions are permitted.

   Refer to Initializing the Crypto Officer Role and Changing a Partition Role Credential.
2. Install the **lnh_cluster** secure package on the Luna Network HSM 7.
   a. Transfer the secure package update file to the Luna Network HSM 7 using **pscp** or **scp**.

   pscp <path>**/lnh_cluster-1.0.#-###.spkg admin@**<appliance_host/IP>**:**
   b. Using a serial or SSH connection, log in to the appliance as **admin** (see Logging In to LunaSH).
   c. Log in as HSM SO (see Logging In as HSM Security Officer).

   lunash:> **hsm login**

d. [Optional] Verify that the secure package file is present on the Luna Network HSM 7.

lunash:> **package listfile**

e. [Optional] Verify the package file, specifying the authorization code you received from Thales.

lunash:> **package verify** <filename>**.spkg -authcode** <code_string>

f. Install the secure package for the **cluster** service.

lunash:> **package update lnh_cluster-1.0.#-###.spkg -authcode** <authcode_string>

The new **cluster** and **keyring** commands become available when you open a new LunaSH session.

3. Set the IP address to use for the core cluster traffic on this member appliance. This must be the same IP address as one of the appliance's network interfaces.

> **NOTE** The core IP address cannot be changed later, except after factory reset.

lunash:> **cluster config -service core -ipaddress** <appliance_IP>

4. If you want the service to restart automatically on appliance reboot, enable the **cluster** service on the appliance. Enabling the service will automatically start it. Otherwise, start the **cluster** service.

To enable the cluster service:

lunash:> **cluster enable**

To start the cluster service without enabling it:

lunash:> **service start cluster**

> **NOTE** The **cluster** service cannot be started if a user partition has not yet been created (refer to step 1).

5. Check the status of the **cluster** service (`enabled` and/or `running`).

lunash:> **cluster status**

> **NOTE** It can take up to 1-2 minutes for the **cluster** service to start. Until startup is complete, the status is reported as **starting**.

6. [Optional] You can also bind the administrative and cryptographic traffic to the cluster to specified network devices, including assigning a port number from a limited range (**admin**: **50075-50079**, **crypto**: **50055-50059**).

lunash:> **cluster config -service admin** [**-interface** <netdevice>] [**-port** <port>]

lunash:> **cluster config -service crypto** [**-interface** <netdevice>] [**-port** <port>]

> **CAUTION!** In this release, changing the default port used for crypto operations on the cluster (**50052**) can cause communication problems between cluster members. Refer to known issue LUNA-26485.

7. [Optional] Check that the network configuration was set correctly.

lunash:> **cluster config show**

You can now create a new cluster on the appliance (see "Creating a Cluster" on page 23) or join a cluster on a different appliance (see "Adding a New Member to an Existing Cluster" on page 25).

CHAPTER 3: Managing Cluster Members

These procedures will allow you to add new members to an existing cluster, remove a functioning member, or delete a non-functioning member from the cluster configuration:

NOTE Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

Creating a Cluster

The following procedures will allow you to create a new cluster on the Luna Network HSM 7 appliance, and authorize the local member on the appliance to create objects on the cluster, using "REST API" below calls or "LunaSH" on page 25.

NOTE This procedure applies to the first cluster member only, or to a cluster of one appliance. The member on which the cluster is created is the *primary* member, and this affects the behavior of the cluster as a whole. Refer to "The Primary Member" on page 12 for more information. If you want to join the appliance to an existing cluster, see "Adding a New Member to an Existing Cluster" on page 25.

CAUTION! Only one cluster can exist on the appliance. Do not attempt to create more than one cluster, or join a second cluster when the appliance is already a member of a cluster.

REST API

Prerequisites

> If you are creating a cluster on a multifactor quorum-authenticated HSM, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To create a cluster and authorize the first member

1. Create a cluster on the appliance. You must specify the HSM SO password (or `"password": ""` and present the HSM SO PED key) and a label for the new cluster.

   POST /api/clusters

   ```
   {
     "authentication": [
       {
         "type": "SO",
         "password": "IamtheHSMSO"
       }
     ],
     "clusterLabel": "myNewCluster"
   }
   ```

2. A default member is created on the cluster with the name **LNH-<HSM_SN>**. Display a list of members on the cluster to find its Member ID.

   GET /api/clusters/{clusterID}/members

3. Authorize the member to create objects on the cluster's keyrings by specifying the application partition, and CO password (or `"password": ""` and present the CO PED key).

   PUT /api/clusters/{clusterID}/members/{memberID}

   ```
   {
     "action": "authorize",
     "authentication": [
       {
         "type": "CO",
         "password": "IamtheCO",
         "partitionLabel": "clusterpar"
       }
     ]
   }
   ```

   > **TIP** Manual member authorization is required only:
   > - to authorize the first member of a cluster
   > - when recovering a cluster with a single member that has failed
   > - when manually reinstating the first member of a cluster where *all* members failed
   >
   > In a cluster where at least one member remains active and connected, rejoining members automatically take their authorization from that member, and manual re-authorization is not needed.

   You can now create new keyrings on the cluster (see "Managing Keyrings" on page 37).

4. You must run the provided **LNHClientRegistration** script on any Luna HSM Client computers that will query this member to create or use keyrings on the cluster. See "Cluster-Client Connections" on page 34 for the procedure.

LunaSH

Prerequisites

> If you are creating a cluster on a multifactor quorum-authenticated HSM, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To create a cluster and authorize the first member

1. Create a cluster on the appliance. You must specify the HSM SO password/PED key and a label for the new cluster. Do not create more than one cluster.

   lunash:> **cluster create -label** <label> [**-password** <HSMSO_password>]

2. A default member is created on the cluster with the name **LNH-<HSM_SN>**. Display a list of members on the cluster to find its Member ID.

   lunash:> **cluster member list -clusterid** <UUID>

3. Authorize the member to create objects on the cluster's keyrings by specifying the application partition, CO password/PED key, and Member ID.

   lunash:> **cluster member authorize -partition** <label> **-memberid** <string> [**-copassword** <password>]

   > **TIP** Manual member authorization is required only:
   > > to authorize the first member of a cluster
   > > when recovering a cluster with a single member that has failed
   > > when manually reinstating the first member of a cluster where *all* members failed
   >
   > In a cluster where at least one member remains active and connected, rejoining members automatically take their authorization from that member, and manual re-authorization is not needed.

   You can now create new keyrings on the cluster (see "Managing Keyrings" on page 37).

4. You must run the provided **LNHClientRegistration** script on any Luna HSM Client computers that will query this member to create or use keyrings on the cluster. See "Cluster-Client Connections" on page 34 for the procedure.

Adding a New Member to an Existing Cluster

Use this procedure to connect a Luna Network HSM 7 appliance to an existing cluster created on another appliance using "REST API" below or "LunaSH" on page 27.

REST API

Prerequisites

> On Appliance A (where the cluster is created):

- The appliance must be configured for clustering (see "Installing and Configuring the Cluster Package" on page 16).
- A cluster must be created on the appliance, and the appliance must be authorized as a member (see "Creating a Cluster" on page 23).
- Thales recommends that new members join the primary cluster member. If there are already multiple members in the cluster, and you are not sure which is currently the primary member, use (the primary member returns `"primarynode": true`):

  GET /api/clusters/{clusterID}/members/{memberID}

> On Appliance B (that will join the existing cluster):

- The appliance must be configured for clustering (see "Installing and Configuring the Cluster Package" on page 16).

> **NOTE** If a cluster already exists on appliance B, it will not be allowed to join appliance A's cluster.

> Both appliances must be accessible to each other over the network. All members of a cluster must be able to communicate bi-directionally with all other members.

> If you are joining a cluster on a multifactor quorum-authenticated HSM, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

> Both appliances should have NTP configured, or the appliance clocks must be synchronized manually; if the appliance times are out of sync by more than 30 seconds, the new member will not be allowed to join the cluster:

Using NTP (actionid: **synchronize**)**:** POST /api/lunasa/ntp/actions/{actionid}

Manually: PUT /api/lunasa/time

> **CAUTION!** Ensure that you add only one member to the cluster at a time. Undesired behavior can result from adding more than one member simultaneously.

To join an existing cluster

1. On appliance A, get the cluster ID you wish to join.

   GET /api/clusters

   Return:

```
{
  "data": [
    {
      "clusterLabel": "myCluster",
      "clusterUUID": "528b9b72-c305-4dd1-bebc-a4ca24f8c28b"
    }
  ]
}
```

2. On appliance B, join appliance A's cluster by specifying its cluster ID, IP address, **admin** user password, the label of the partition on appliance B that will authorize appliance B as a member, and that partition's CO password (or `"password": ""` and present the CO PED key).

PUT /api/clusters/{clusterID}

```
{
  "authentication": [
    {
      "type": "CO",
      "password": "IamtheCO",
      "partitionLabel": "clusterpar"
    }
  ],
  "remoteClusterIpAddress": "127.0.0.1",
  "remoteAdminPassword": "Iamtheadmin",
  "action": "join"
}
```

> **NOTE** This operation may take a few minutes, even though a success message is received right away.

New members joining an existing cluster are authorized automatically.

3. Confirm that both cluster members are now listed. If they are not, wait a few minutes and try again -- the join process may still be underway.

   GET /api/clusters/{clusterID}/members

4. You must run the provided **LNHClientRegistration** script on any Luna HSM Client computers that will query this member to create or use keyrings on the cluster. See "Cluster-Client Connections" on page 34 for the procedure.

LunaSH

Prerequisites

> On Appliance A (where the cluster is created):

- The appliance must be configured for clustering (see "Installing and Configuring the Cluster Package" on page 16).
- A cluster must be created on the appliance, and the appliance must be authorized as a member (see "Creating a Cluster" on page 23).
- Thales recommends that new members join the primary cluster member. If there are already multiple members in the cluster, and you are not sure which is currently the primary member, use (the primary member is marked with a "**P**"):

  lunash:> **cluster member list -clusterid** <UUID>

> On Appliance B (that will join the existing cluster):

- The appliance must be configured for clustering (see "Installing and Configuring the Cluster Package" on page 16).

> **NOTE** If a cluster already exists on appliance B, it will not be allowed to join appliance A's cluster.

- Both appliances must be accessible to each other over the network. All members of a cluster must be able to communicate bi-directionally with all other members.
- If you are joining a cluster on a multifactor quorum-authenticated HSM, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.
- Both appliances should have NTP configured, or the appliance clocks must be synchronized manually; if the appliance times are out of sync by more than 30 seconds, the new member will not be allowed to join the cluster. See Setting the System Date and Time.

> **CAUTION!** Ensure that you add only one member to the cluster at a time. Undesired behavior can result from adding more than one member simultaneously.

To join an existing cluster

1. On appliance A, get the cluster ID you wish to join.

   lunash:> **cluster list**

2. On appliance B, join appliance A's cluster by specifying its cluster ID, IP address, **admin** user password, the label of the partition on appliance B that will authorize appliance B as a member, and that partition's CO password/PED key.

   lunash:> **cluster join -clusterid** <string> **-clusteripaddress** <ipaddress> **-remotepassword** <adminpassword> **-partition** <name> [**-copassword** <password>] [**-force**]

3. Confirm that both cluster members are now listed. An asterisk indicates the local member.

   lunash:> **cluster member list -clusterid** <UUID>

   New members joining an existing cluster are authorized automatically.

4. You must run the provided **LNHClientRegistration** script on any Luna HSM Client computers that will query this member to create or use keyrings on the cluster. See "Cluster-Client Connections" on page 34 for the procedure.

Moving a Member to a Different Affinity Group

Luna Network HSM 7s within a cluster can be added to an affinity group. Operations from a connected client application are load-balanced between members of the same group only. This allows you to use the other members, which can be at a remote location with greater latency, as backup or standby members for a specific client. If all members of a client's preferred group are unavailable, operations then fail over to other members of the cluster. The state of keyrings and objects stored on them is always synchronized across all members of the cluster, regardless of group. You can create up to 64 affinity groups in a cluster.

New members are added to the **local** group by default and can be moved to another group using "REST API" on the next page or "LunaSH" on the next page.

REST API

To move a member to another group

Move the member to the new group, specifying the group name. If the group does not already exist, a new group is created with the specified name.

PUT /api/clusters/{clusterID}/members/{memberID}

```
{
    "action": "config",
    "group": "newgroup"
}
```

LunaSH

To move a member to another group

1. Move the member to the new group, specifying the group name. If the group does not already exist, a new group is created with the specified name.

   lunash:> **cluster member config** **-memberid** <UUID> **-group** <name>

2. [Optional] Check the new group configuration.

   lunash:> cluster group list

Promoting a Member to Primary

This procedure allows you to promote any member of the cluster to be the primary member (see "The Primary Member" on page 12 for more information) using "REST API" below or "LunaSH" on the next page. You can promote any active cluster member to primary from any other active member.

REST API

Prerequisites

> The member being promoted must have read-write privileges on the cluster. If you are promoting another member because the original primary member is unrecoverable, you must first delete the original primary from the cluster before you can promote your desired member (see "Deleting an Unrecoverable Member From a Cluster" on page 31).

To promote a member to primary

1. Check that the member you wish to promote has read-write privileges (`"mode": "Read-Write"`).

   GET /api/clusters/{clusterID}/members/{memberID}

2. Promote the member to primary.

   PUT /api/clusters/{clusterID}/members/{memberID}


```
{
    "action": "config",
    "primary": true
}
```

> **NOTE** If you have automatic scheduled backups configured, you must disable and re-enable backups after promoting a new primary member. You do not need to re-configure the schedule.
>
> PUT /api/clusters/{clusterID}/backup

LunaSH

Prerequisites

> The member being promoted must have read-write privileges on the cluster. If you are promoting another member because the original primary member is unrecoverable, you must first delete the original primary from the cluster before you can promote your desired member (see "Deleting an Unrecoverable Member From a Cluster" on the next page).

To promote a member to primary

1. Ensure the member you wish to promote has read-write privileges (`Mode: Read-Write`).

   lunash:> **cluster member show -memberid** <UUID>

2. Promote the member to primary.

   lunash:> **cluster member config -memberid** <UUID> **-primary**

3. [Optional] Check the new primary status (`Primary: True`).

   lunash:> **cluster member show -memberid** <UUID>

> **NOTE** If you have automatic scheduled backups configured, you must disable and re-enable backups after promoting a new primary member. You do not need to re-configure the schedule.
>
> lunash:> **cluster backup disable**
>
> lunash:> **cluster backup enable -backuppassword** <password>

Removing a Functioning Member From a Cluster

This procedure allows you to remove a functioning member from the cluster using "REST API" on the next page or "LunaSH" on the next page. This could be done for scheduled maintenance or updates, and assumes that the member is accessible and functioning properly within the cluster. This operation must be done on the member appliance that is leaving the cluster.

> **CAUTION!** Ensure that all other members are online before you proceed. If another member is offline, it will not be updated with the new cluster configuration, and its cluster service may need to be factory reset as a result.

REST API

Prerequisites

> If you are removing a member from a multifactor quorum-authenticated HSM cluster, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To remove a member from the cluster

1. Check that the member you wish to remove can communicate with the other cluster members (`"visibleToServicingNode": true`).

   GET /api/clusters/{clusterID}/members/{memberID}

2. Remove the member from the cluster, specifying the label of the partition containing the cluster SMK and the CO password (or `"password": ""` and present the CO PED key).

   PATCH /api/clusters/{clusterID}/members/{memberID}

```
{
  "authentication": [
    {
      "type": "CO",
      "password": "IamtheCO",
      "partitionLabel": "clusterpar"
    }
  ],
  "action": "leave"
}
```

LunaSH

Prerequisites

> If you are removing a member from a multifactor quorum-authenticated HSM cluster, you require a local or remote PED key. Refer to Multifactor Quorum Authentication for setup procedures.

To remove a member from the cluster

1. Check that the member you wish to remove is the local member (`Local: True`) and can communicate with the other cluster members (`Visible: True`).

   lunash:> **cluster member show -memberid** <UUID>

2. Remove the member from the cluster, specifying the local partition and its Crypto Officer password/PED key.

   lunash:> **cluster leave -memberid** <UUID> **-partition** <label> [**-copassword** <password>]

Deleting an Unrecoverable Member From a Cluster

This procedure allows you to delete a member from the cluster that has become unrecoverable and cannot be accessed via SSH or REST API. This action removes references to the unrecoverable member from the other members of the cluster. This operation must be done on another cluster member using "REST API" on the next page or "LunaSH" on the next page.

> **CAUTION!** Ensure that all members except those being deleted are online before you proceed. If another member is offline, it will not be updated with the new cluster configuration, and its cluster service may need to be factory reset as a result.

REST API

Prerequisites

> If you are deleting a member from a multifactor quorum-authenticated HSM cluster, you require a local or remote PED key. Refer to Multifactor Quorum Authentication for setup procedures.

To delete an unrecoverable member from the cluster

1. Check that the member you wish to remove is not visible to the other cluster members (`"visibleToServicingNode": false`).

   GET /api/clusters/{clusterID}/members/{memberID}

2. Delete the member from the cluster, specifying the Crypto Officer password (or `"password": ""` and present the CO PED key) for the local cluster partition.

   DELETE /api/clusters/{clusterID}/members/{memberID}

```
{
    "authentication":
    [{
        "type": "CO",
        "password": "IamtheCO"
    }]
}
```

> **NOTE** If the member you just removed was the primary member, another member is automatically promoted to primary and read-write cluster function resumes. If you prefer to use a different member as primary, see "Promoting a Member to Primary" on page 29.
>
> When you are able to re-establish an SSH, REST, or serial connection to the deleted member appliance, you must factory reset its **cluster** service before rejoining it to the cluster (serviceid: **cluster**, actionid: **factoryreset**):
>
> POST /api/lunasa/services/{serviceid}/actions/{actionid}
>
> lunash:> **sysconf config factoryreset -service cluster**

LunaSH

Prerequisites

> If you are deleting a member from a multifactor quorum-authenticated HSM cluster, you require a local or remote PED key. Refer to Multifactor Quorum Authentication for setup procedures.

To delete an unrecoverable member from the cluster

1. Check that the member you wish to remove is not visible to the other cluster members (`Visible: False`).

lunash:> **cluster member show -memberid** <UUID>

2. Delete the member from the cluster, specifying the Crypto Officer password/PED key for the local cluster partition.

   lunash:> **cluster member delete -memberid** <UUID> [**-copassword** <password>]

> **NOTE** If the member you just removed was the primary member, another member is automatically promoted to primary and read-write cluster function resumes. If you prefer to use a different member as primary, see "Promoting a Member to Primary" on page 29.
>
> When you are able to re-establish an SSH, REST, or serial connection to the deleted member appliance, you must factory reset its **cluster** service before rejoining it to the cluster (serviceid: **cluster**, actionid: **factoryreset**):
>
> POST /api/lunasa/services/{serviceid}/actions/{actionid}
>
> lunash:> **sysconf config factoryreset -service cluster**

CHAPTER 4: Cluster-Client Connections

Thales provides a client-side script, **LNHClientRegistration**, to connect Luna HSM Client to a cluster. You must run the script on any Luna HSM Client computers that will create or use keyrings on the cluster. The client requires a specified member Luna Network HSM 7 to use as an entry point to the cluster. All traffic from the client will be directed to this member appliance, although the operations may be performed by other cluster members.

> **NOTE**
>
> - The **LNHClientRegistration** script included with Luna HSM Client 10.7.2 and newer is larger than in previous versions; it has been signed by Thales, like all other client binaries released for Windows platforms.
> - Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

If this client will be used by a customer with **monitor** privileges in a service provider deployment, you can specify a LunaSH username to associate with the client. This can be the default **monitor** role, or a custom user with the **monitor** role assigned (see Creating Custom Appliance User Accounts). The specified user must already exist on the appliance.

Connecting Luna HSM Client to a Cluster

The following procedure will allow you to connect a Luna HSM Client computer to a Luna Network HSM 7 cluster. Each cluster is assigned an index number from 00 to 09 on the client. In this release, the configuration can be viewed only in the **crystoki.ini** / **Chrystoki.conf** configuration file; the following entries for each cluster are added to the **LunaSA Client** section (see Configuration File Summary):

```
LNHServer##
LNHServerClientCert##
LNHServerClientKey##
LNHServerCAFile##
LNHServerCN##
```

Prerequisites

- Ensure that you have a supported Luna HSM Client version installed. Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

> **CAUTION!** Using Luna HSM Client 10.7.2, running the script while specifying the same common name (usually an IP address) that was used to create an existing NTLS certificate causes the existing NTLS private key to be deleted. To preserve this key, located in **<install directory>/data/client_identities/**, save a copy in another location and restore it after running the registration script. Refer to known issue LUNA-32033.

Refer to Updating the Luna HSM Client Software.

> Ensure that you have the following information about each cluster you want to access using this client:

- the Cluster ID
- the IP address for an *authorized* member appliance that will accept this client's traffic

> If you customize the port numbers for admin traffic to the appliance, you must edit the **LNHClientRegistration** script to account for these port numbers, or client registration will fail. To update the script, replace all instances of the default admin port **50070** with your configured admin port.

> **CAUTION!** In this release, changing the default port used for crypto operations on the cluster (**50052**) can cause communication problems between cluster members. Refer to known issue LUNA-26485.

To connect Luna HSM Client to a cluster member

1. Run the **LNHClientRegistration** script to connect the client to the cluster, specifying the Cluster ID (**-c**), the IP address of the member the client will connect to (**-i**), a Common Name for the client certificate (**-n**), an optional label for the client (**-l**), and an optional LunaSH username with a **monitor** role to associate with this client (**-u**). This assigns the cluster to the 00 index position on the client.

   - **Linux/AIX:**

     # **./LNHClientRegistration.sh -n** <client Common Name> **-i** <IPaddress> **-c** <clusterID> [**-l** <optional_client_label>] [**-u** <monitor_LunaSH_user>]

   - **Windows PowerShell:**

     ./LNHClientRegistration.ps1 -n <client Common Name> **-i** <IPaddress> **-c** <clusterID> [**-l** <optional_client_label>] [**-u** <monitor_LunaSH_user>]

   - **Windows command prompt:**

     powershell.exe -command "LNHClientRegistration.ps1 -n <client Common Name> **-i** <IPaddress> **-c** <clusterID> [**-l** <optional_client_label>] [**-u** <monitor_LunaSH_user>]**"**

2. Run the script again for each additional cluster you wish to add, including the **-m** option to indicate that you are adding multiple clusters. Each new cluster added will be assigned to the next incremental index position (01, 02, 03... 09). If all the positions are filled, an error message is returned.

   > **CAUTION!** Running the script again without the **-m** option will overwrite the cluster configuration at the 00 index position. However, do not replace a cluster configuration this way; stop your client applications and delete the existing cluster configuration before running the script again. See "Removing a Cluster From the Luna HSM Client" on the next page.

   - **Linux/AIX:**

     # **./LNHClientRegistration.sh -n** <client Common Name> **-i** <IPaddress> **-c** <clusterID> [**-l** <optional_client_label>] [**-u** <monitor_LunaSH_user>] **-m**

   - **Windows PowerShell:**

     LNHClientRegistration.ps1 -n <client Common Name> **-i** <IPaddress> **-c** <clusterID> [**-l** <optional_client_label>] [**-u** <monitor_LunaSH_user>] **-m**

- **Windows command prompt:**

  powershell.exe -command "LNHClientRegistration.ps1 -n <client Common Name> **-i** <IPaddress> **-c** <clusterID> [**-l** <optional_client_label>] [**-u** <monitor_LunaSH_user>] **-m"**

Removing a Cluster From the Luna HSM Client

In this release, to remove a cluster from the client, you must manually delete it from the index by editing the LunaSA Client section of the **crystoki.ini** / **Chrystoki.conf** configuration file. First, stop all applications on this client that are using the cluster you will remove. Delete the entries for that cluster and save the configuration file.

```
LunaSA Client = {
   ReceiveTimeout = 20000;
   SSLConfigFile = /usr/safenet/lunaclient/bin/openssl.cnf;
   ClientPrivKeyFile = /usr/safenet/lunaclient/cert/client/ClientNameKey.pem;
   ClientCertFile = /usr/safenet/lunaclient/cert/client/ClientNameCert.pem;
   ServerCAFile = /usr/safenet/lunaclient/cert/server/CAFile.pem;
   NetClient = 1;
   TCPKeepAlive = 1;

   LNHServer00 = 1.2.3.4:50052;
   LNHServerClientCert00 = /usr/safenet/lunaclient/cert/client/c2c94c40-6491-409e-bd3d-
16e236544b7f/2.3.4.5.pem;
   LNHServerClientKey00 = /usr/safenet/lunaclient/cert/client/c2c94c40-6491-409e-bd3d-
16e236544b7f/2.3.4.5Key.pem;
   LNHServerCAFile00 = /usr/safenet/lunaclient/cert/server/c2c94c40-6491-409e-bd3d-
16e236544b7f/lnh_ca.pem;
   LNHServerCN00 = lnh.thalesgroup.com;
   LNHServer01 = 5.6.7.8:50052;
   LNHServerClientCert01 = /usr/safenet/lunaclient/cert/client/3fed78e8-58ad-4aec-be5f-
4a12a04ff073/2.3.4.5.pem;
   LNHServerClientKey01 = /usr/safenet/lunaclient/cert/client/3fed78e8-58ad-4aec-be5f-
4a12a04ff073/2.3.4.5Key.pem;
   LNHServerCAFile01 = /usr/safenet/lunaclient/cert/server/3fed78e8-58ad-4aec-be5f-
4a12a04ff073/lnh_ca.pem;
   LNHServerCN01 = lnh.thalesgroup.com;
}
```

CHAPTER 5: Managing Keyrings

The procedures below will allow you to create a new keyring on a cluster, and configure it for use by a Luna HSM Client. Up to 3500 keyrings can be created on the cluster, and each keyring can contain up to 256 objects. Each Luna HSM Client can manage up to 3500 keyrings, which can be spread across multiple clusters.

> "Creating New Keyrings" below

> "Configuring Keyring Roles" on the next page

> "Deleting a Keyring" on page 39

> **NOTE** Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

Creating New Keyrings

Use this procedure to create new keyrings on an existing cluster using "REST API" below or "LunaSH" on the next page.

REST API

Prerequisites

> If you are creating keyrings on a multifactor quorum-authenticated HSM cluster, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To create new keyrings

1. Create keyrings on the cluster by specifying a label and initial password, and the label and CO password (or `"password": ""` and present the CO PED key) for the partition that will generate the keyrings. To create multiple keyrings (up to 100 at a time), specify the number to be created (**total** in **--data**). Each keyring will be given the specified label with an appended index number. You can use **index** in **--data** to specify the starting number for the group of keyrings.

   Up to 3500 keyrings can be created on the cluster, and each keyring can contain up to 256 objects. Each Luna HSM Client can manage up to 3500 keyrings, which can be spread across multiple clusters.

   POST /api/keyrings

```
{
  "authentication": [
    {
      "type": "CO",
      "password": "IamtheCO",
      "partitionLabel": "clusterpar"
    }
```

```
  ],
  "keyRingLabel": "myKeyring",
  "keyRingPassword": "keyringpassword",
  "total": 10,
  "index": 100
}
```

2. [Optional] List the keyrings available on the cluster. Each individual keyring is listed along with its UUID.

   GET /api/keyrings

3. [Optional] Display the attributes for an individual keyring by specifying its UUID.

   GET /api/keyrings/{keyringID}

You must now use LunaCM on the Luna HSM Client machine to configure the keyring for cryptographic applications. See "Configuring Keyring Roles" below.

LunaSH

Prerequisites

> If you are creating keyrings on a multifactor quorum-authenticated HSM cluster, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To create new keyrings

1. Create keyrings on the cluster by specifying its label and initial password, and the label and CO password/PED key for the partition that will generate the keyring. To create multiple keyrings (up to 100 at a time), specify the number to be created using the **-total** option. Each keyring will be given the specified label with an appended index number. You can use the **-index** option to specify the starting number for the group of keyrings.

   Up to 3500 keyrings can be created on the cluster, and each keyring can contain up to 256 objects. Each Luna HSM Client can manage up to 3500 keyrings, which can be spread across multiple clusters.

   lunash:> **keyring create -label** <label> **-password** <password> **-partition** <partition_label> **-total** <number> **-index** <number> [**-copassword** <password>]

2. [Optional] List the keyrings available on the cluster. Each individual keyring is listed along with its UUID.

   lunash:> **keyring list**

3. [Optional] Display the attributes for an individual keyring by specifying its UUID.

   lunash:> **keyring show -keyringid** <UUID>

Configuring Keyring Roles

Use this procedure to initialize the keyring roles required for creating and using objects on the keyring. The keyring has its own administrative roles, analogous to the Partition SO and Crypto Officer roles (see Partition Roles). For clarity, they are referred to here as the Keyring Security Officer (KRSO) and Keyring Crypto Officer (KRCO) roles, although they use the same commands as the partition roles. The procedure is intended to enforce role separation between the Keyring Security Officer and the Keyring Crypto Officer, the same way roles are separated on standard Luna HSM partitions.

This procedure uses LunaCM on a registered Luna HSM Client.

To configure roles on the keyring

1. Run LunaCM and confirm that all your created keyrings are available as slots. Note the slot number and label of the keyring you wish to configure.
2. The initial password you set during keyring creation belongs to the KRSO role (called the PO in LunaCM). Log in as KRSO.

   lunacm:> **role login -name po**
3. The KRSO password must now be changed to enforce role separation between the cluster administrator and the keyring user.

   lunacm:> **role changepw -name po**

   NOTE The KRCO password is what your applications will specify to access the keyring and create and use objects. Thales recommends that you always use the most secure password possible. The length of your KRSO/KRCO password affects the behavior of the keyring as follows:

   > If the KRCO password is 16 characters or shorter, the keyring is locked after 10 failed login attempts and must be unlocked before it can be used again:

     PATCH /api/keyrings/{keyringID}

     lunash:> **keyring unlock** {**-keyringid** <string> | **-label** <name>} [**-copassword** <password>]

   > If the KRCO password is 17 characters or longer, the lockout counter is not incremented.

   Failed login attempts using 6 characters or less never increment the counter.
4. Initialize the KRCO role on the keyring. Ensure that you set the same password for this role that you set for the KRSO.

   lunacm:> **role init -name co**

   The KRCO can now log in and use the keyring for key creation and most cryptographic operations, just as you would a standard Luna application partition.

Deleting a Keyring

Use this procedure to delete a keyring using "REST API" below or "LunaSH" on the next page.

REST API

Prerequisites

> If you are deleting keyrings on a multifactor quorum-authenticated HSM cluster, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To delete a keyring

1. [Optional] List the keyrings available on the cluster. Each individual keyring is listed along with its UUID.

   GET /api/keyrings

2. Delete the keyring by specifying either its label or UUID, and the CO password (or `"password": ""` and present the CO PED key) for the cluster partition.

   DELETE /api/keyrings/{keyringID}

```
{
  "authentication": [
    {
      "type": "CO",
      "password": "IamtheCO"
    }
  ]
}
```

LunaSH

Prerequisites

> If you are deleting keyrings on a multifactor quorum-authenticated HSM cluster, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To delete a keyring

1. [Optional] List the keyrings available on the cluster. Each individual keyring is listed along with its UUID.

   lunash:> **keyring list**

2. Delete the keyring by specifying either its label or UUID, and the CO password/PED key for the cluster partition.

   lunash:> **keyring delete** {**-label** <keyringlabel> | **-keyringid** <UUID>} [**-copassword** <password>]

CHAPTER 6: Cluster Backup and Restore

These procedures allow you to back up the contents of a cluster to an encrypted file on the appliance, using REST API or LunaSH:

> "Backing Up/Restoring the Cluster SMK" below
> "Backing Up a Cluster" on page 43
> "Restoring a Cluster from Backup" on page 45

> **NOTE** Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

Backing Up/Restoring the Cluster SMK

All keyrings on the cluster are encrypted with a SKS Master Key (SMK), which is stored on the V1 partition that created the cluster and cloned to the V1 partition on each joining cluster member. In the highly unlikely event that the SMK is lost from all members, the entire cluster is unrecoverable. Therefore, Thales recommends backing up the SMK to a Luna Backup HSM as part of your general recovery plan. This procedure requires an initialized Luna Backup HSM connected to the appliance. You must use LunaSH to back up or restore the cluster SMK.

Backing Up the Cluster SMK

Use the following procedure to back up the Cluster SMK to a Luna Backup HSM.

Prerequisites

> The Luna Backup HSM must be connected to a USB port on the Luna Network HSM 7 appliance.
> If you are backing up the SMK on a multifactor quorum-authenticated HSM, you require a local or remote Luna PED. Refer to Multifactor Quorum Authentication for setup procedures.

To back up the cluster SMK

1. Log in to LunaSH as **admin**, or a custom user with **admin** privileges.
2. [Optional] View the Luna Backup HSMs currently connected to the appliance and find the correct serial number.

   lunash:> **token backup list**
3. If you have not already done so, initialize the backup HSM, specifying its serial number and a label.

   lunash:> **token backup init -label** <backup_hsm_label> **-serial** <backup_hsm_SN>

   You are prompted to set the backup HSM SO password and a cloning domain string.

4. Initiate the backup operation, specifying the cluster partition label, a label for the backup (either a new label or the label, or an existing backup you wish to overwrite), and the Backup HSM serial number.

   If you omit the **-tokenpar** option when creating a new backup, the backup is assigned a default name (<source_partition_name>_<YYYYMMDD>).

   lunash:> **partition backup -partition** <cluster_partition_label> **-serial** <Backup_HSM_SN> [**-tokenpar** <target_label>]

   You are prompted for the following credentials:

   a. Crypto Officer password/PED key for the cluster partition
   b. HSM SO password/PED key for the backup HSM (Luna Backup HSM 7 only)
   c. New password/PED key for the backup partition
   d. Domain string or PED key for the backup partition (must match the cluster partition domain)

   The backup operation begins once you have completed the authentication process.

Restoring the Cluster SMK

Use the following procedure to restore the cluster SMK from a Luna Backup HSM.

Prerequisites

> Do not restore the SMK to a partition that is already encrypting a cluster on the Luna Network HSM 7. You must restore the SMK before creating a new cluster. It is not necessary to restore the SMK on each member of a cluster; the SMK is replicated to each new member when it joins the cluster on the primary member.

To restore the cluster SMK from backup

Do not restore the cluster SMK to a Luna Network HSM 7 that has an existing cluster

1. Log in to LunaSH as **admin**, or a custom user with **admin** privileges.
2. [Optional] View the Luna Backup HSMs currently connected to the appliance and find the correct serial number.

   lunash:> **token backup list**

3. [Optional] View the backups currently available on the Backup HSM.

   lunash:> **token backup partition list -serial** <Backup_HSM_serialnum>

4. Initiate the restore operation, specifying the cluster partition label, the backup label, the Backup HSM serial number, and the **-add** option.

   lunash:> **partition restore -partition** <target_label> **-tokenpar** <backup_label> **-serial** <Backup_HSM_SN> **-add**

   You are prompted for the following credentials:

   a. Crypto Officer password/PED key for the backup
   b. Crypto Officer password/PED key for the cluster partition

   The restore operation begins once you have completed the authentication process. When it is complete, you can create a new cluster on the appliance (see "Creating a Cluster" on page 23).

Backing Up a Cluster

Use this procedure to back up the contents of a cluster to an encrypted file on the appliance using "REST API" below or "LunaSH" on the next page. You can perform backups on demand or schedule periodic backups. This procedure does not restore the SMK used to encrypt the contents of the cluster. Refer to "Backing Up/Restoring the Cluster SMK" on page 41.

> **NOTE** Ensure that the member you are using to back up the cluster is authorized at the time of backup; otherwise the backup will fail.

REST API

Prerequisites

- Backup and restore operations can only be done on the primary member of the cluster.
- The **cluster** service must be running on the appliance and the member must be authorized.

To back up a cluster manually

Back up the cluster by specifying its UUID, a filename for the backup file, and a password that will be required to restore from this backup.

> **NOTE** Using the same filename as an existing backup will overwrite the existing file.

PUT /api/clusters/{clusterID}/backup

```
{
  "action": "run",
  "password": "backuppassword",
  "filename": "myClusterBackup"
}
```

To schedule periodic backups

1. If you already have backups scheduled, and you wish to make changes, first disable the backup service.

   PUT /api/clusters/{clusterID}/backup

   ```
   {
     "action": "disable"
   }
   ```

2. Set the backup schedule by specifying a filename prefix that will be used to name all backup files (`"filename"`), the number of backups you would like to store before old backups are deleted (`"total"`, valid range **1-15**), and the time you want backup to occur (`"time"`) in the format **d:hh:mm** (where **d** is a number representing the day of the week as follows: **0** == Sunday, **1** == Monday, **2** == Tuesday, etc).

   The filename you specify may have a maximum length of 64 characters. The following characters are allowed:

   `-.0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ_abcdefghijklmnopqrstuvwxyz`

   PUT /api/clusters/{clusterID}/backup

```
{
  "action": "config",
  "total": 5,
  "time": "7:09:30",
  "filename": "myClusterBackup"
}
```

3. Enable the backup service, specifying a password that will be required to restore from any of the scheduled backups.

   PUT /api/clusters/{clusterID}/backup

```
{
  "action": "enable",
  "password": "backuppassword"
}
```

4. [Optional] Display the scheduled backup configuration.

   PUT /api/clusters/{clusterID}/backup

```
{
  "action": "show"
}
```

All backups are available on the appliance in the **admin** user's files. The scheduled backup configuration is not affected by rebooting the appliance or restarting the **cluster** service. However, you must restart the **cluster** service after changing the appliance time zone or after a daylight savings time change, or the new time will not be reflected in the backup schedule.

> **NOTE** If you promote a new cluster member to primary, you must disable and re-enable scheduled backups. You do not need to re-configure the schedule.
>
> PUT /api/clusters/{clusterID}/backup

LunaSH

Prerequisites

- Backup and restore operations can only be done on the primary member of the cluster.
- The **cluster** service must be running on the appliance and the member must be authorized.
- You must be logged in to LunaSH as **admin** to do backup/restore operations.

To back up a cluster manually

Back up the cluster by specifying its UUID, a filename for the backup file, and a password that will be required to restore from this backup.

> **NOTE** Using the same filename as an existing backup will overwrite the existing file.

The filename you specify may have a maximum length of 64 characters. The following characters are allowed:

```
-.0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ_abcdefghijklmnopqrstuvwxyz
```

lunash:> **cluster backup run** **-clusterid** <string> **-filename** <filename> **-backuppassword** <password>

To schedule periodic backups

1. If you already have backups scheduled, and you wish to make changes, first disable the backup service.

   lunash:> **cluster backup disable**

2. Set the backup schedule by specifying the cluster UUID (**-clusterid**), a filename prefix that will be used to name all backup files (**-filename**), the number of backups you would like to store before old backups are deleted (**-number** <**1-15**>), and the time you want backup to occur (**-time**) in the format **d:hh:mm** (where **d** is a number representing the day of the week as follows: **0** == Sunday, **1** == Monday, **2** == Tuesday, etc).

   The filename you specify may have a maximum length of 64 characters. The following characters are allowed:

   `-.0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ_abcdefghijklmnopqrstuvwxyz`

   lunash:> **cluster backup config -clusterid** <string> **-filename** <filename> **-number** <number> **-time** <string>

3. Enable the backup service, specifying a password that will be required to restore from any of the scheduled backups.

   lunash:> **cluster backup enable -backuppassword** <password>

4. [Optional] Display the scheduled backup configuration.

   lunash:> **cluster backup show**

All backups are available on the appliance in the **admin** user's files. To view them, use lunash:> **my file list**. The scheduled backup configuration is not affected by rebooting the appliance or restarting the **cluster** service. However, you must restart the cluster service after changing the appliance time zone or after a daylight savings time change, or the new time will not be reflected in the backup schedule.

> **NOTE** If you promote a new cluster member to primary, you must disable and re-enable scheduled backups. You do not need to re-configure the schedule.
>
> lunash:> **cluster backup disable**
>
> lunash:> **cluster backup enable -backuppassword** <password>

Restoring a Cluster from Backup

Use this procedure to restore the primary cluster member from backup using "REST API" on the next page or "LunaSH" on page 47.

> **CAUTION!** Restoring the cluster from backup is a service-disrupting operation; do not perform client operations on the cluster until the restore process is complete.

NOTE

- Keyrings can be restored to a different cluster than the one where they were created, as long as the new cluster uses the same cluster SMK. If the cluster SMK is destroyed and cannot be restored from backup, keyrings are unrecoverable.
- Keyrings on the target cluster have their configuration (roles, passwords, lock status) restored to their backup state. Objects stored on keyrings are overwritten by their backup versions. Keyrings and objects that do not have a backup version are left unchanged by the restore operation.

REST API

Prerequisites

- Backup and restore operations can only be done on the primary member of the cluster.
- The **cluster** service must be running on the appliance and the member must be authorized.
- Stop the **cluster** service on all non-primary members of the cluster before you begin the restore operation (serviceid: **cluster**, actionid: **stop**):

  POST /api/lunasa/services/{serviceid}/actions/{actionid}

To restore a cluster from backup

1. Restore the cluster from backup by specifying the backup filename, the backup password, and the **keyring** type of restore operation.

   PUT /api/cluster/restore

   ```
   {
     "filename": "myBackupFile",
     "password": "backuppassword",
     "type": "keyring"
   }
   ```

   NOTE This operation takes longer for larger clusters.

2. [Optional] Check the status of the restore operation.

   GET /api/cluster/restore

3. When the restore operation is complete, you may start the **cluster** service on each non-primary member, one at a time (serviceid: **cluster**, actionid: **start**). Wait until each member is authorized before starting the next member. The amount of time it takes for each member to be authorized may vary, depending on the size of the data restored.

   POST /api/lunasa/services/{serviceid}/actions/{actionid}

   Confirm that the member is authorized (`"memberActive": true`) before starting the next member:

   GET /api/clusters/{clusterID}/members

4. Restart the **cluster** service on the primary member (serviceid: **cluster**, actionid: **restart**). This step is required in this release; refer to known issue LUNA-31648.

POST /api/lunasa/services/{serviceid}/actions/{actionid}

LunaSH

Prerequisites

- Backup and restore operations can only be done on the primary member of the cluster.
- The **cluster** service must be running on the appliance and the member must be authorized.
- You must be logged in to LunaSH as **admin** to do backup/restore operations.
- Stop the **cluster** service on all non-primary members of the cluster before you begin the restore operation:

  lunash:> **service stop cluster**

To restore a cluster from backup

1. Restore the cluster from backup by specifying the backup filename, the backup password, and the **keyring** type of restore operation.

   lunash:> **cluster restore run -filename** <filename> **-type keyring -restorepassword** <password>

   > **NOTE** This operation takes longer for larger clusters.

2. [Optional] Check the status of the restore operation.

   lunash:> **cluster restore show**

3. When the restore operation is complete, you may start the **cluster** service on each non-primary member, one at a time. Wait until each member is authorized before starting the next member. The amount of time it takes for each member to be authorized may vary, depending on the size of the data restored.

   lunash:> **service start cluster**

   Confirm that the member is authorized (`Authorized: True`) before starting the next member:

   lunash:> cluster member show

4. Restart the **cluster** service on the primary member. This step is required in this release; refer to known issue LUNA-31648.

   lunash:> **service restart cluster**

CHAPTER 7: Updating the Cluster

Use these instructions to perform software/firmware/package updates on all members of a cluster.

With the latest release, Thales is pleased to announce that "Clusters" on page 10 are fully supported for new production deployments, designed to reduce operation cost and maximize the return on investment of a fleet of HSMs. This release does not provide a migration path from standard Luna partitions or Luna Cloud HSM services to keyrings. Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

NOTE Unlike the PSO and CO roles on standard Luna partitions, the KRSO and KRCO roles on each keyring are intended to be held by the same individual, and use the same password. When the password for one role is changed, the change is applied to the other role as well. Consider this distinction when planning your cluster deployment and setting your KRSO passwords.

CAUTION! ***DO NOT INSTALL THE CLUSTER PACKAGE ON A LUNA NETWORK HSM WITH PARTITIONS ALREADY IN PRODUCTION***

When the **lnh_cluster** package is installed, access to any existing partitions on the HSM is disabled, and this can only be reversed by re-imaging the Luna Network HSM 7 appliance (see Re-Imaging the Appliance to Factory Baseline). Re-imaging is a destructive action; all roles, partitions, and keys are destroyed. The Luna Network HSM 7 must be completely reconfigured; all partitions must be recreated and their contents restored from backup. In particular, do not attempt to configure clustering on a Luna Network HSM 7 that already has V1 partitions created; either delete these partitions or re-image the appliance before configuring a cluster.

Checking the Installed Version

There are three methods of checking which version of the **lnh_cluster** package is installed on the Luna Network HSM 7.

Get Cluster Member Information

The installed **lnh_cluster** version is included in the output of the following LunaSH and REST API commands. These commands can be run on any member in the cluster, but you must specify the UUID for the member you want information for:

> **REST API:** GET /api/clusters/{clusterID}/members/{memberID}

> **LunaSH:** lunash:> cluster member show

Check List of Installed Packages on the Luna Network HSM 7

The installed **lnh_cluster** version can be found in the list of installed packages in the format **cluster_service-#.#.#-#####.x86_64**:

> **REST API:** GET /api/lunasa/packages

> **LunaSH:** lunash:> package list

Search supportInfo.txt File

The installed **lnh_cluster** version can be found in the **supportInfo.txt** file generated by the following LunaSH and REST API commands:

> **REST API:** POST /api/lunasa/hsms/{hsmid}/supportInfo

> **LunaSH:** lunash:> hsm supportInfo

Transfer the file to a client computer using pscp**/scp** or another secure method, and search for the string **cluster_service**:

grep cluster_service supportInfo.txt

Updating a Multi-Member Cluster

The following procedure will allow you to update the appliance software, firmware, and **lnh_cluster** package on all members of a cluster, using "REST API" below or "LunaSH" on the next page. The cluster can remain active during this procedure; client applications can keep running, except for during client update.

REST API

Prerequisites

> All cluster members must be functioning and visible to the primary member (`"memberActive": true`, `"visibleToServicingNode": true`, `"restartService": false`).

GET /api/clusters/{clusterID}/members

To update all members of an active cluster using REST API

1. Identify the primary cluster member (`"primaryNode": true`).

   GET /api/clusters/{clusterID}/members

2. Choose one of the *non-primary* members to update.

   a. Stop the **cluster** service on that member (serviceid: **cluster**, actionid: **stop**).

   POST /api/lunasa/services/{serviceid}/actions/{actionid}

   b. Disable the **cluster** service to prevent automatic restart during the update procedure (serviceid: **cluster**, actionid: **disable**).

   POST /api/lunasa/services/{serviceid}/actions/{actionid}

c. Update the Luna Network HSM 7 appliance software. You must be updating from Luna Network HSM 7 Appliance Software 7.8.3 or newer to use REST API for this action.

POST /api/lunasa/packageFiles

If you are updating from an older appliance software version, refer to the LunaSH procedure (Updating the Luna Network HSM 7 Appliance Software).

d. Update the Luna HSM firmware (actionid: **upgrade**).

POST /api/lunasa/hsms/{hsmid}/firmware/actions/{actionid}

e. Update the **cluster** package and restart the **cluster** service. You require Luna Network HSM 7 Appliance Software 7.8.3 or newer to use REST API for this action (version you updated to in step **b** above).

POST /api/lunasa/packageFiles

The member becomes active again.

f. You can now re-enable the **cluster** service (serviceid: **cluster**, actionid: **enable**).

POST /api/lunasa/services/{serviceid}/actions/{actionid}

Repeat step 2 for each *non-primary* member, one at a time.

3. Promote one of the updated members to primary.

Refer to "Promoting a Member to Primary" on page 29.

4. Repeat step 2 for the final (formerly primary) member.
5. [Optional] If you wish, promote the original primary member back to primary.

Refer to "Promoting a Member to Primary" on page 29.

6. Update the Luna HSM Client software.

Refer to Updating the Luna HSM Client Software.

After updating the client, you may restart applications from that client. Repeat for each additional client.

LunaSH

Prerequisites

> All cluster members must be functioning and visible to the primary member (not displayed in the list with an `x` or `R`).

lunash:> cluster member list

To update all members of an active cluster using LunaSH

1. Identify the primary cluster member.

lunash:> cluster member list

The primary member is displayed in the list with a `P`.

2. Choose one of the *non-primary* members to update. Log in to LunaSH on the appliance as **admin**.

a. Stop the **cluster** service.

lunash:> service stop **cluster**

b. Disable the **cluster** service to prevent automatic restart during the update procedure.

lunash:> cluster disable

c. Update the Luna Network HSM 7 appliance software.

Refer to Updating the Luna Network HSM 7 Appliance Software.

d. Update the Luna HSM firmware.

Refer to Updating the Luna HSM Firmware.

e. Update the **cluster** package and restart the **cluster** service.

Refer to "Updating the Cluster" on page 48.

At this point, the member becomes active again.

f. You can now re-enable the **cluster** service.

lunash:> cluster enable

Repeat step 2 for each *non-primary* member, one at a time.

3. Promote one of the updated members to primary.

Refer to "Promoting a Member to Primary" on page 29.

4. Repeat step 2 for the final (formerly primary) member.
5. [Optional] If you wish, promote the original primary member back to primary.

Refer to "Promoting a Member to Primary" on page 29.

6. Stop your client applications and update the Luna HSM Client software.

Refer to Updating the Luna HSM Client Software.

After updating the client, you may restart applications from that client. Repeat for each additional client.

Updating a Single-Member Cluster

The following procedure will allow you to update the appliance software, firmware, and **cluster** package on a single-member cluster, using "REST API" below or "LunaSH" on the previous page. Since the cluster contains only one member, this will be a service-disrupting operation.

> **NOTE** Thales requires minimum Luna Appliance Software 7.8.5 with the lnh_cluster-1.0.4 package, Luna HSM Firmware 7.8.4, and Luna HSM Client 10.7.2 to use clusters in production environments.

REST API

Prerequisites

> Stop all client applications during the update process.

To update the single-member cluster using REST API

1. Stop the **cluster** service (serviceid: **cluster**, actionid: **stop**).

POST /api/lunasa/services/{serviceid}/actions/{actionid}

2. Disable the **cluster** service to prevent automatic restart during the update procedure (serviceid: **cluster**, actionid: **disable**).

   POST /api/lunasa/services/{serviceid}/actions/{actionid}

3. Update the Luna Appliance Software. You must be updating from Luna Network HSM 7 Appliance Software 7.8.3 or newer to use REST API for this action.

   POST /api/lunasa/packageFiles

   If you are updating from an older appliance software version, refer to the LunaSH procedure (Updating the Luna Network HSM 7 Appliance Software).

4. Update the Luna HSM firmware (actionid: **upgrade**).

   POST /api/lunasa/hsms/{hsmid}/firmware/actions/{actionid}

5. Update the **cluster** package and restart the **cluster** service. You require Luna Network HSM 7 Appliance Software 7.8.3 or newer to use REST API for this action (version you updated to in step **3** above).

   POST /api/lunasa/packageFiles

6. Manually authorize the member by specifying the cluster partition, and CO password (or `"password": ""` and present the CO PED key).

   PUT /api/clusters/{clusterID}/members/{memberID}

```
{
  "action": "authorize",
  "authentication": [
    {
      "type": "CO",
      "password": "IamtheCO",
      "partitionLabel": "clusterpar"
    }
  ]
}
```

7. You can now re-enable the **cluster** service (serviceid: **cluster**, actionid: **enable**).

   POST /api/lunasa/services/{serviceid}/actions/{actionid}

8. Update the Luna HSM Client software.

   Refer to Updating the Luna HSM Client Software.

   After updating the client, you may restart applications from that client. Repeat for each additional client.

LunaSH

Prerequisites

> Stop all client applications during the update process.

To update the single-member cluster using REST API

1. Stop the **cluster** service.

   lunash:> service stop **cluster**

2. Disable the **cluster** service to prevent automatic restart during the update procedure.

   lunash:> cluster disable

3. Update the Luna Network HSM 7 appliance software.

   Refer to Updating the Luna Network HSM 7 Appliance Software.

4. Update the Luna HSM firmware.

   Refer to Updating the Luna HSM Firmware.

5. Update the **cluster** package and restart the **cluster** service.

   Refer to "Updating the Cluster" on page 48.

6. Manually authorize the member by specifying the application partition, CO password/PED key, and Member ID.

   lunash:> **cluster member authorize -partition** <label> **-memberid** <string> [**-copassword** <password>]

7. You can now re-enable the **cluster** service.

   lunash:> cluster enable

8. Update the Luna HSM Client software.

   Refer to Updating the Luna HSM Client Software.

   After updating the client, you may restart applications from that client. Repeat for each additional client.

Troubleshooting

If you encounter any issues, refer to Reading System Logs to check recent activity on the appliance. To report an issue that is not described below, export the appliance syslog to a client workstation and provide it to your Thales representative (refer to Exporting System Logs).

