THALES

Keycloak

INTEGRATION GUIDE

THALES LUNA HSM

Document Information

Document Part Number	007-001280-001
Revision	C
Release Date	9 February 2023

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CONTENTS

Overview

Keycloak is an open source identity and access management solution aimed at modern applications and services. It makes it easy to secure applications and services with little or no code. It provides advanced features such as user federation, identity brokering, and social login. Keycloak is based on standard protocols and provides support for OpenID Connect, OAuth 2.0, and SAML.

This guide demonstrates how to generate the Keycloak realm signing keys on Luna HSM. Realm signing key is used to sign the access token and XML documents between the authentication server and the application. Using a Luna HSM to generate the realm signing keys for Keycloak provides the following benefits:

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

Certified Platforms

This integration is tested on the following platforms:

HSM Type	Platforms Tested	JDK Version	Keycloak Version
Luna HSM	RHEL 8	Open JDK 11	15.1.0, 15.0.2, 13.0.1
Luna HSM	RHEL 7	Open JDK 8	13.0.1, 12.0.1, 11.0.1, 10.0.1, 9.0.2

Thales Luna HSM: Thales 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. Thales Luna HSMs physically and logically secure cryptographic keys and accelerate cryptographic processing. The Luna HSM on premise offerings include the Luna Network HSM, PCIe HSM, and Luna USB HSMs.

NOTE: The integration with Keycloak requires Luna Client v10.4 or above.

NOTE: Obtain a patch from Thales Support containing Keycloak Luna plugin that will enable the Keycloak to use Luna Keystore and signing keys generated on Luna HSM.

NOTE: Although README attached to the patch refers to a single supported version of Keycloak, refer to the table provided at the beginning of the Certified Platforms section for the Keycloak versions that are actually certified.

Prerequisites

Complete the following tasks before you begin the installation:

Configure Luna HSM

Set up and configure the Luna HSM device for your system. Refer to Thales Luna HSM Product Documentation for help.

1. Ensure that the HSM is set up, initialized, provisioned, and ready for deployment.
2. Create a partition on the HSM for use by Keycloak.
3. If you are using a Thales Luna Network HSM, register a client for the system and assign the client to a partition to create an NTLS connection.
4. Initialize the Crypto Officer and Crypto User roles for the initialized partition.
5. Verify that the partition is successfully registered and configured. The command to see the registered partition is:

```
lunacm (64-bit) v10.4.0-417. Copyright (c) 2021 SafeNet. All rights
reserved.

        Available HSMs:

        Slot Id ->              0
        Label ->                INTG01
        Serial Number ->        1312109861412
        Model ->                LunaSA 7.7.0
        Firmware Version ->     7.7.0
        Bootloader Version ->   1.1.2
        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
```

NOTE: Refer to Thales Luna Network HSM Product Documentation for detailed steps about creating NTLS connection, initializing partition, and assigning user roles.

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.

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.

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

Set up Thales Luna HSM High-Availability (HA)

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

Download Keycloak Luna SPI Patch

Keycloak does not provide support for Luna HSM Keystore, but facilitates development of a plugin using Signature Provider Interface (SPI) that leverages the Luna HSM Keystore. Contact Thales Customer Support to obtain Keycloak Luna plugin. Thales Customer Support will provide you a patch containing Keycloak Luna plugin that you can use to enable Keycloak to use Luna Keystore and signing keys generated on Luna HSM.

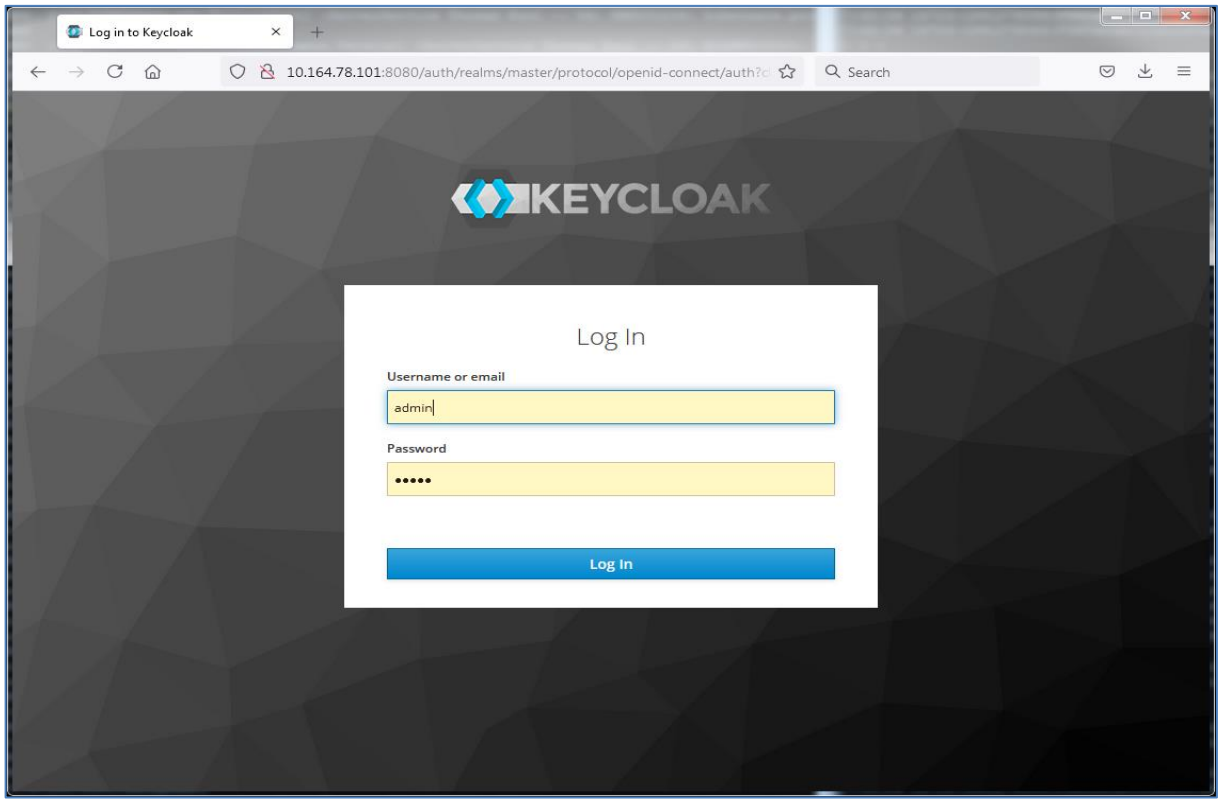
NOTE: README attached to the patch refers to a single supported version of Keycloak but this guide takes precedence as to what actual versions of Keycloak are supported.

Install Java Development Kit

Ensure that the Java Development Kit (JDK) is installed on your server or local computer. You can run the commands provided in this guide, wherever you have the `keytool` utility available.

Set up Keycloak Server

To log in to the Keycloak Admin console, ensure that the Keycloak server is installed and running and you have created the initial Admin user. Consult the Keycloak documentation for detailed instructions about installing and setting up a Keycloak server: https://www.keycloak.org/documentation.



Configuring Keycloak to use Luna HSM

This section demonstrates the steps required for generating signing keys and certificate on Luna HSM and configuring the Keycloak realm to use the HSM generated key for token signing and XML document signing. Following are the steps involved in achieving Keycloak and Luna HSM integration:

> Configure Java for Luna Keystore

> Generate signing keys and certificate on Luna Keystore

> Configure Keycloak Luna Plugin

> Configure Keycloak to use signing keys from Luna Keystore

Configure Java for Luna Keystore

To generate the signing keys on Luna HSM using Java, configure Java to use the Luna Provider.

1. Set the environment variables for `JAVA_HOME` and `PATH`.

```
# export JAVA_HOME=<JDK_installation_directory>
# export PATH=$JAVA_HOME/bin:$PATH
```

```
[root@keycloak ~]#
[root@keycloak ~]# export JAVA_HOME=/usr/lib/jvm/java-1.8.0-openjdk-1.8.0.222.b03-1.el7.x86_64
[root@keycloak ~]# export PATH=$JAVA_HOME/bin:$PATH
[root@keycloak ~]#
```

2. Copy the `libLunaAPI.so` and `LunaProvider.jar` file from the `<Luna_installation_directory>/jsp/lib` directory to the `<JDK_installation_directory>/jre/lib/ext` directory.

   NOTE: Skip this step, if using JDK 11, as JDK 11 doesn't support to copy the provider.

3. Edit the Java Security Configuration file provider list, as shown below:

   For JDK 11:

   `$JAVA_HOME/conf/security/java.security`

```
security.provider.1=SUN
security.provider.2=SunEC
security.provider.3=SunJSSE
security.provider.4=SunJCE
security.provider.5=SunJGSS
security.provider.6=SunSASL
security.provider.7=XMLDSig
security.provider.8=SunPCSC
security.provider.9=JdkLDAP
security.provider.10=JdkSASL
security.provider.11=SunPKCS11
security.provider.12=com.safenetinc.luna.provider.LunaProvider
security.provider.13=SunRsaSign
```

   For JDK 8:

   `$JAVA_HOME/jre/lib/security/java.security`

```
security.provider.1=sun.security.provider.Sun
security.provider.2=sun.security.rsa.SunRsaSign
security.provider.3=sun.security.ec.SunEC
security.provider.4=com.sun.net.ssl.internal.ssl.Provider
security.provider.5=com.sun.crypto.provider.SunJCE
security.provider.6=sun.security.jgss.SunProvider
security.provider.7=com.sun.security.sasl.Provider
security.provider.8=org.jcp.xml.dsig.internal.dom.XMLDSigRI
security.provider.9=sun.security.smartcardio.SunPCSC
security.provider.10=com.safenetinc.luna.provider.LunaProvider
```

4. Save and close the `java.security` file.
5. Create a file named lunastore (it could be any user defined name) and add the following entry, where `<partition_label>` will be the Luna HSM partition name.

   ```
   tokenlabel:<partition_label>
   ```

6. Save the `lunastore` file in the current working directory, let's say `/opt`.

Generate signing key and certificate on Luna Keystore

Keytool utility provided by JDK will be used to generate the signing keys and certificate on the Luna HSM. To generate signing keys:

1. Generate a signing key and certificate using the Java `keytool` utility leveraging Luna keystore. This will generate the key pair in Luna HSM.

   For JDK 11:

   ```
   # keytool -genkeypair -alias lunakey -keyalg RSA -keysize 2048 -sigalg
   SHA256withRSA -keypass userpin1 -keystore lunastore -storetype luna -
   storepass userpin1 -providerpath
   "/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar" -providerclass
   com.safenetinc.luna.provider.LunaProvider -J-
   Djava.library.path=/usr/safenet/lunaclient/jsp/lib/ -J-cp -
   J/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar
   ```

   For JDK 8:

   ```
   # keytool -genkeypair -alias lunakey -keyalg RSA -keysize 2048 -sigalg
   SHA256withRSA -keypass userpin1 -keystore lunastore -storetype luna -
   storepass userpin1
   ```

   When the above command is run, you need to provide certificate details. A new key pair will be generated on the Luna HSM.

   > **NOTE:** The command above uses "userpin1" as storepass which is the partition's Crypto Officer pin set during initializing the CO role for the partition. You can use the same password for keypass.

2. Generate a certificate request for signing key in the Luna keystore.

   For JDK 11:

   ```
   # keytool -certreq -alias lunakey -sigalg SHA256withRSA -file certreq_file
   -keystore lunastore -storetype luna -providerpath
   "/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar" -providerclass
   com.safenetinc.luna.provider.LunaProvider -J-
   Djava.library.path=/usr/safenet/lunaclient/jsp/lib/ -J-cp -
   J/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar
   ```

   For JDK 8:

   ```
   # keytool -certreq -alias lunakey -sigalg SHA256withRSA -file certreq_file
   -keystore lunastore -storetype luna
   ```

   Enter the keystore password, when prompted. A file named `certreq_file` will be generated in the current directory.

3. Submit the CSR file to your Certification Authority (CA). The CA will authenticate the request with the Code Signing template and return a signed certificate or a certificate chain. Save the reply and the root certificate of the CA in the current working directory.
4. Import the CA root certificate and signed certificate or certificate chain to the keystore.

   For JDK 11:

   To import the CA root certificate, execute the following command:

   ```
   # keytool -trustcacerts -importcert -alias rootca -file root.cer -keystore
   lunastore -storetype luna -providerpath
   "/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar" -providerclass
   com.safenetinc.luna.provider.LunaProvider -J-
   Djava.library.path=/usr/safenet/lunaclient/jsp/lib/ -J-cp -
   J/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar
   ```

   To import the signed certificate reply or certificate chain, execute the following command:

   ```
   # keytool -importcert -trustcacerts -alias lunakey -file signing.p7b -
   keystore lunastore -storetype luna -providerpath
   "/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar" -providerclass
   com.safenetinc.luna.provider.LunaProvider -J-
   Djava.library.path=/usr/safenet/lunaclient/jsp/lib/ -J-cp -
   J/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar
   ```

   For JDK 8:

   To import the CA root certificate, execute the following command:

   ```
   # keytool -trustcacerts -importcert -alias rootca -file root.cer -keystore
   lunastore -storetype luna
   ```

   To import the signed certificate reply or certificate chain, execute the following command:

   ```
   # keytool -importcert -trustcacerts -alias lunakey -file signing.p7b -
     keystore lunastore -storetype luna
   ```

   Where root.cer and signing.p7b are the CA Root Certificate and Signed Certificate Chain, respectively. Enter the keystore password, when prompted.
5. Verify the keystore contents in the Luna HSM.

   For JDK 11:

   To display the contents in `lunastore`, execute the following command:

   ```
   # keytool -list -v -keystore lunastore -storetype luna -providerpath
   "/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar" -providerclass
   com.safenetinc.luna.provider.LunaProvider -J-
   Djava.library.path=/usr/safenet/lunaclient/jsp/lib/ -J-cp -
   J/usr/safenet/lunaclient/jsp/lib/LunaProvider.jar
   ```

   For JDK 8:

   To display the contents in `lunastore`, execute the following command:

   ```
   # keytool -list -v -keystore lunastore -storetype luna
   ```

```
[root@keycloak opt]# keytool -list -v -storetype luna -keystore lunastore
Enter keystore password:
Keystore type: LUNA
Keystore provider: LunaProvider

Your keystore contains 2 entries

Alias name: lunakey
Creation date: Jun 2, 2021
Entry type: PrivateKeyEntry
Certificate chain length: 2
Certificate[1]:
Owner: CN=Administrator, CN=Users, DC=thaleshsm, DC=com
Issuer: CN=ORGCA, DC=thaleshsm, DC=com
Serial number: 14000000a59ad15742ad96b4590000000000a5
Valid from: Wed Jun 02 16:01:31 IST 2021 until: Thu Jun 02 16:01:31 IST 2022
Certificate fingerprints:
         MD5:  75:40:1B:95:D3:B3:F8:05:5F:42:A4:99:41:87:06:D3
         SHA1: F1:25:DA:70:40:89:17:39:5C:05:41:FE:E3:36:DB:FC:0E:07:BE:D4
         SHA256: CE:7F:DA:B2:9E:75:40:0B:09:09:8D:91:EB:0D:8E:50:E3:74:30:91:90:E8:99:BC:2E:CD:65:6D:CA:D4:B5:FD
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3
Certificate[2]:
Owner: CN=ORGCA, DC=thaleshsm, DC=com
Issuer: CN=ORGCA, DC=thaleshsm, DC=com
Serial number: 6532c42d59f069b245089dc5d129b2c1
Valid from: Tue Feb 09 15:25:40 IST 2021 until: Mon Feb 09 15:35:38 IST 2026
Certificate fingerprints:
         MD5:  70:0A:DE:C6:4F:65:F9:28:A2:42:9B:87:72:1E:5D:82
         SHA1: 91:AF:11:9C:3F:BA:E9:CB:19:A4:09:3E:B1:06:3C:BA:BC:96:CE:56
         SHA256: 90:D9:D1:32:0D:77:99:F1:43:4A:37:39:A4:8F:51:CC:80:D3:93:58:6D:02:EF:96:54:69:2B:92:0A:2D:E6:61
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3


*******************************************
*******************************************


Alias name: rootca
Creation date: Jun 2, 2021
Entry type: trustedCertEntry

Owner: CN=ORGCA, DC=thaleshsm, DC=com
Issuer: CN=ORGCA, DC=thaleshsm, DC=com
Serial number: 6532c42d59f069b245089dc5d129b2c1
Valid from: Tue Feb 09 15:25:40 IST 2021 until: Mon Feb 09 15:35:38 IST 2026
Certificate fingerprints:
         MD5:  70:0A:DE:C6:4F:65:F9:28:A2:42:9B:87:72:1E:5D:82
         SHA1: 91:AF:11:9C:3F:BA:E9:CB:19:A4:09:3E:B1:06:3C:BA:BC:96:CE:56
         SHA256: 90:D9:D1:32:0D:77:99:F1:43:4A:37:39:A4:8F:51:CC:80:D3:93:58:6D:02:EF:96:54:69:2B:92:0A:2D:E6:61
Signature algorithm name: SHA256withRSA
Subject Public Key Algorithm: 2048-bit RSA key
Version: 3


*******************************************
*******************************************
```

Configure Keycloak Luna Plugin

Keycloak does not provide support for the Luna HSM Keystore, but facilitates development of the plugin using Signature Provider Interface (SPI). Contact Thales Customer Support to obtain a patch containing the plugin that will enable Keycloak to use Luna Keystore and signing keys generated on Luna HSM.

1. Extract the patch and copy the Keycloak Luna Plugin zip file (extracted from the patch) to the Keycloak modules directory.

```
# tar -xvf 630-000621-001_SW_Patch_keycloak_integration_Custom_Release.tar
# cp 630-000621-001_SW_Patch_keycloak_integration_Custom_Release/keycloak-spi-luna-keystore-1.0-assemblyModule.zip /opt/keycloak/modules/
```

For Keycloak 15 onwards:

```
# cp 630-000621-001_SW_Patch_keycloak_integration_Custom_Release/keycloak-spi-luna-keystore-1.1-assemblyModule.zip /opt/keycloak/modules/
```

2. Traverse to the Keycloak modules directory and extract the plugin zip file.

```
# cd /opt/keycloak/modules/
# unzip keycloak-spi-luna-keystore-1.0-assemblyModule.zip
```

For Keycloak 15 onwards:

```
# unzip keycloak-spi-luna-keystore-1.1-assemblyModule.zip
```

```
[root@keycloak modules]# unzip keycloak-spi-luna-keystore-1.0-assemblyModule.zip
Archive:  keycloak-spi-luna-keystore-1.0-assemblyModule.zip
   creating: com/
   creating: com/safenetinc/
   creating: com/safenetinc/luna/
   creating: com/safenetinc/luna/keycloak/
   creating: com/safenetinc/luna/keycloak/provider/
  inflating: com/safenetinc/luna/keycloak/provider/module.xml
  inflating: com/safenetinc/luna/keycloak/provider/keycloak-spi-luna-keystore-1.0.jar
[root@keycloak modules]#
```

3. Traverse to the `com/safenetinc/luna` directory and create a `main/lib/linux-x86_64` folder under the `com\safenetinc\luna` directory.

```
# cd /opt/keycloak/modules/com/safenetinc/luna/
# mkdir -p main/lib/linux-x86_64
```

4. Copy the `LunaProvider.jar` file to the main folder created under the `com\safenetinc\luna` directory.

```
# cp <Luna_installation_directory>/jsp/lib/LunaProvider.jar main/
```

5. Copy `libLunaAPI.so` file to the `main/lib/linux-x86_64` directory created under the `com\safenetinc\luna` directory.

```
# cp <Luna_installation_directory>/jsp/lib/libLunaAPI.so main/lib/linux-x86_64
```

6. Create a file `module.xml` in the `main` folder and add the following information in it.

```
# cd main
# vi module.xml
```

```
<module name="com.safenetinc.luna" xmlns="urn:jboss:module:1.9">
  <resources>
    <resource-root path="LunaProvider.jar"/>
  </resources>
  <dependencies>
   <module name="java.logging"/>
  </dependencies>
</module>
```

7. Ensure that the `LunaProvider.jar`, `module.xml`, and `lib/linux-x86_64/libLunaAPI.so` files are present in the `/opt/keycloak/modules/com/safenetinc/luna/main` directory that you've created.

```
[root@keycloak main]# ls -ltr /opt/keycloak/modules/com/safenetinc/luna/main/
total 628
drwxr-xr-x. 3 root root     26 Jun 11 20:57 lib
-rw-r--r--. 1 root root 638381 Jun 11 20:58 LunaProvider.jar
-rw-r--r--. 1 root root    218 Jun 11 21:58 module.xml
[root@keycloak main]#
```

8. Traverse to the `com/safenetinc/luna/keycloak/provider` directory created in the Keycloak's modules directory.

```
# cd /opt/keycloak/modules/com/safenetinc/luna/keycloak/provider/
```

9. Create a `main` folder under the `com/safenetinc/luna/keycloak/provider` directory.

```
# mkdir main
```

10. Move the `keycloak-spi-luna-keystore-1.0.jar` and `module.xml` to the main directory.

```
# mv keycloak-spi-luna-keystore-1.0.jar module.xml main/
```

For Keycloak 15 onwards:

```
# mv keycloak-spi-luna-keystore-1.1.jar module.xml main/
```

11. Ensure that the `keycloak-spi-luna-keystore-x.x.jar` and `module.xml` are present in the `/opt/keycloak/modules/com/safenetinc/luna/keycloak/provider/main` directory that you've created.

    Where `x.x` is the version depending upon the Keycloak version used.

```
[root@keycloak main]# ls -ltr /opt/keycloak/modules/com/safenetinc/luna/keycloak/provider/main
total 16
-rw-rw-r--. 1 root root 9242 Jun  8 14:49 keycloak-spi-luna-keystore-1.0.jar
-rw-rw-r--. 1 root root  752 Jun 11 21:06 module.xml
[root@keycloak main]#
```

12. Ensure that the `module.xml` file has the following content, including the name of the Plugin jar file.

> **NOTE:** For Keycloak v15.x, ensure that "`keycloak-spi-luna-keystore-1.1.jar`" is used.

```
<?xml version='1.0' encoding='UTF-8'?>
<module xmlns="urn:jboss:module:1.3" name="com.safenetinc.luna.keycloak.provider" slot="main">
    <resources>
        <resource-root path="keycloak-spi-luna-keystore-1.0.jar"/>
    </resources>
    <dependencies>
        <module name="org.keycloak.keycloak-server-spi" services="import"/>
        <module name="org.keycloak.keycloak-server-spi-private" services="import"/>
        <module name="org.keycloak.keycloak-core"/>
        <module name="org.keycloak.keycloak-common"/>
        <module name="org.keycloak.keycloak-services"/>
        <module name="org.jboss.resteasy.resteasy-jaxrs"/>
        <module name="org.jboss.logging"/>
        <module name="com.safenetinc.luna"/>
    </dependencies>
</module>
~
```

13. Edit the Keycloak configuration file `standalone.xml` to add the Provider and SPI details as follows:

```
# vi /opt/keycloak/standalone/configuration/standalone.xml
```

```
    <provider>
        module:com.safenetinc.luna.keycloak.provider
    </provider>
     .
     .
     <spi name="keys">
          <provider name="luna-keystore" enabled="true"/>
     </spi>
```

You need to mention the provider and SPI details above in the Provider and SPI sections already present in the XML file. Ensure that `luna-keystore` spi is specified as the first SPI in the list.

```
<subsystem xmlns="urn:jboss:domain:keycloak-server:1.1">
    <web-context>auth</web-context>
    <providers>
        <provider>classpath:${jboss.home.dir}/providers/*</provider>
        <provider>module:com.safenetinc.luna.keycloak.provider</provider>
    </providers>
    <master-realm-name>master</master-realm-name>
    <scheduled-task-interval>900</scheduled-task-interval>
    <theme>
        <staticMaxAge>2592000</staticMaxAge>
        <cacheThemes>true</cacheThemes>
        <cacheTemplates>true</cacheTemplates>
        <dir>${jboss.home.dir}/themes</dir>
    </theme>
    <spi name="keys">
        <provider name="luna-keystore" enabled="true"/>
    </spi>
    <spi name="eventsStore">
        <provider name="jpa" enabled="true">
            <properties>
                <property name="exclude-events" value="[&quot;REFRESH_TOKEN&quot;]"/>
            </properties>
        </provider>
    </spi>
```

14. Save and close the `standalone.xml` file. Now stop the Keycloak server if it is already running, or start it again.

```
# /opt/keycloak/bin/standalone.sh
```

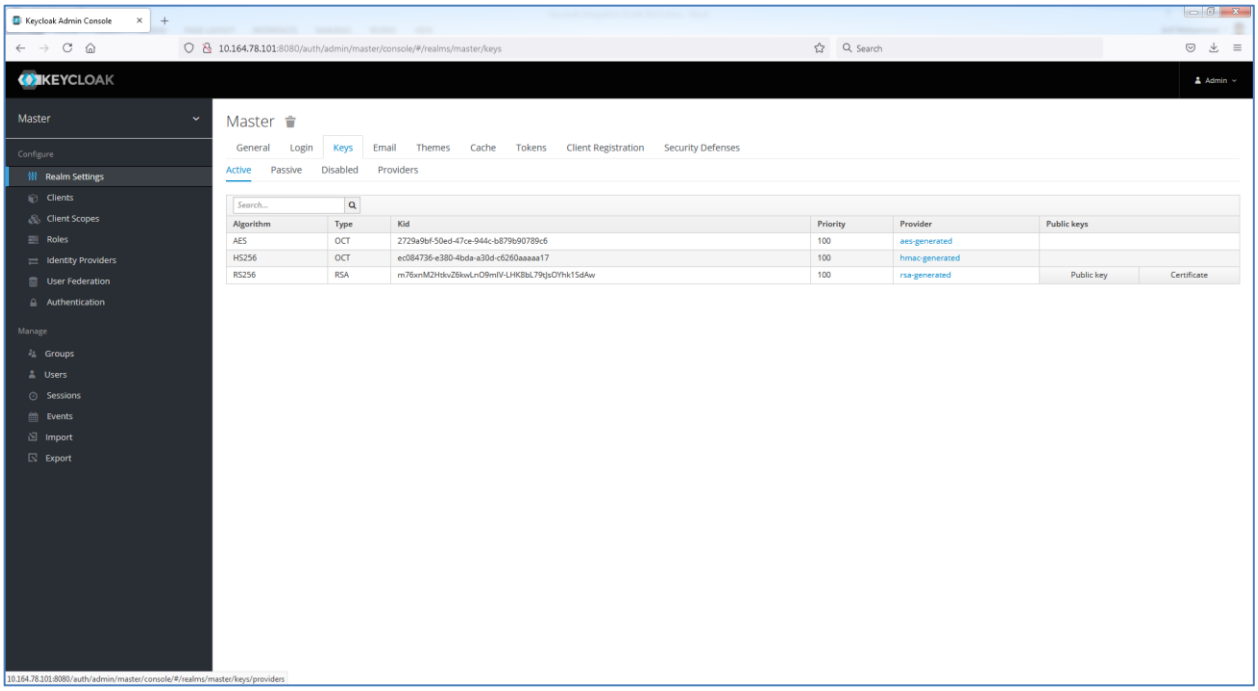
You will see the following information when the server starts.

```
22:27:29,211 INFO  [org.keycloak.services] (ServerService Thread Pool --
   62) KC-SERVICES0001: Loading config from standalone.xml or domain.xml

22:27:29,928 WARN  [org.keycloak.services] (ServerService Thread Pool --
   62) KC-SERVICES0047: luna-keystore
   (com.safenetinc.luna.keycloak.provider.LunaKeystoreProviderFactory) is
   implementing the internal SPI keys. This SPI is internal and may
   change without notice

22:27:30,326 INFO  [org.keycloak.url.DefaultHostnameProviderFactory]
(ServerService Thread Pool -- 62) Frontend: <request>, Admin: <frontend>,
Backend: <request>
```

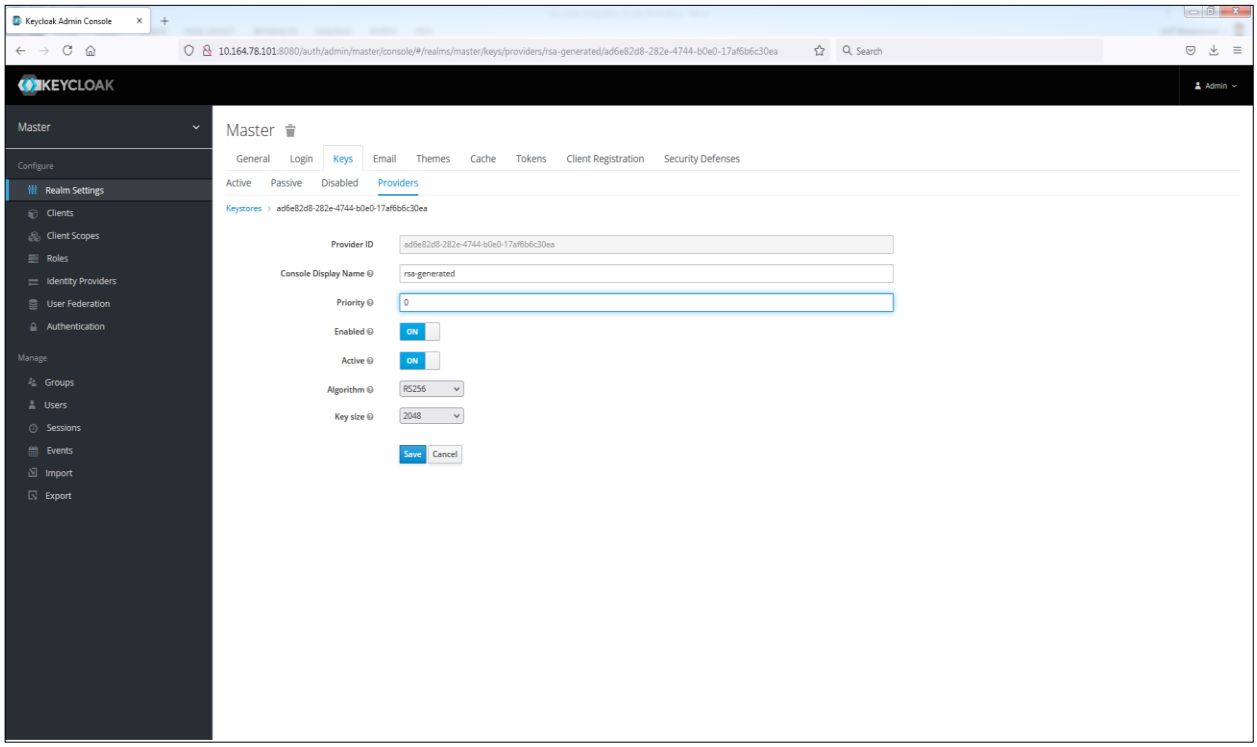
Configure Keycloak to use signing keys from Luna Keystore

Login to the Keycloak Admin Console to configure Luna Keystore which will enable Keycloak to use keys generated on Luna HSM.

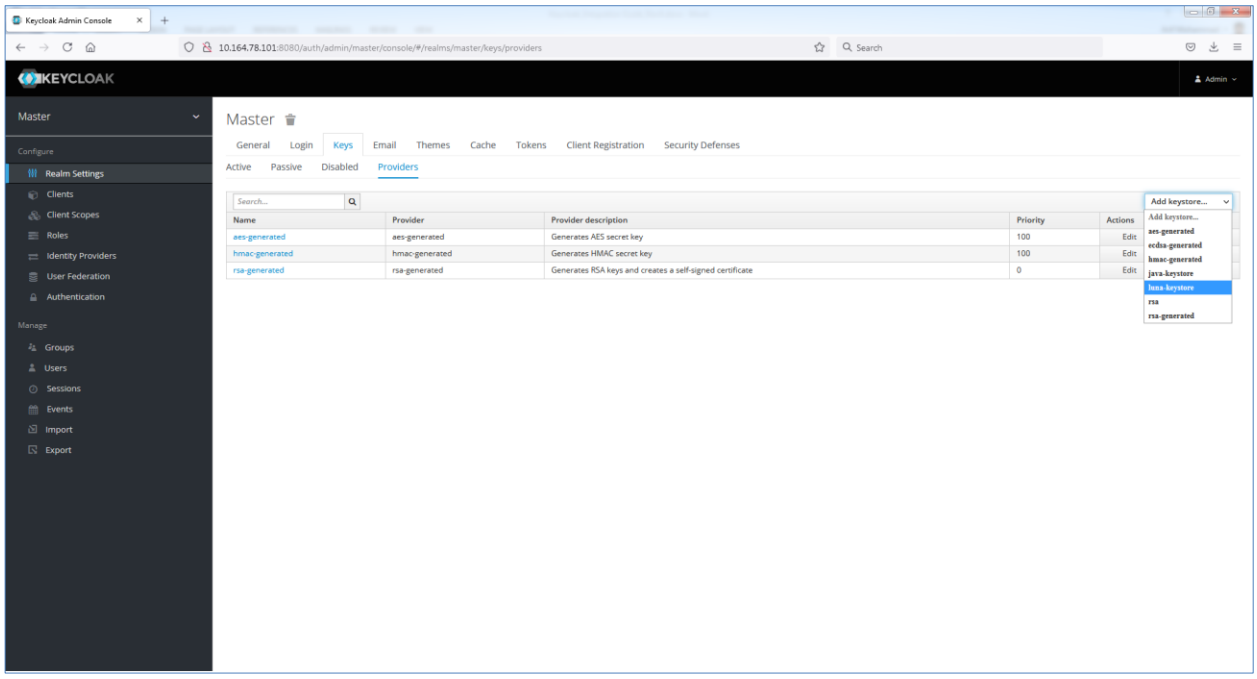
1. Log in to the Keycloak Admin Console and navigate to **Realm Settings** > **Keys**.



2. Click **rsa-generated** key in **Provider** column and change the **Priority** from 100 to 0. Click **Save**.



3. Navigate to **Realm Settings** > **Keys** > **Providers**. Click **Add keystore…** and select **luna-keystore**.



4. Enter the values for **Priority**, **Keystore**, **Keystore Password**, **Key Alias** and **Key Password**. Click **Save**.

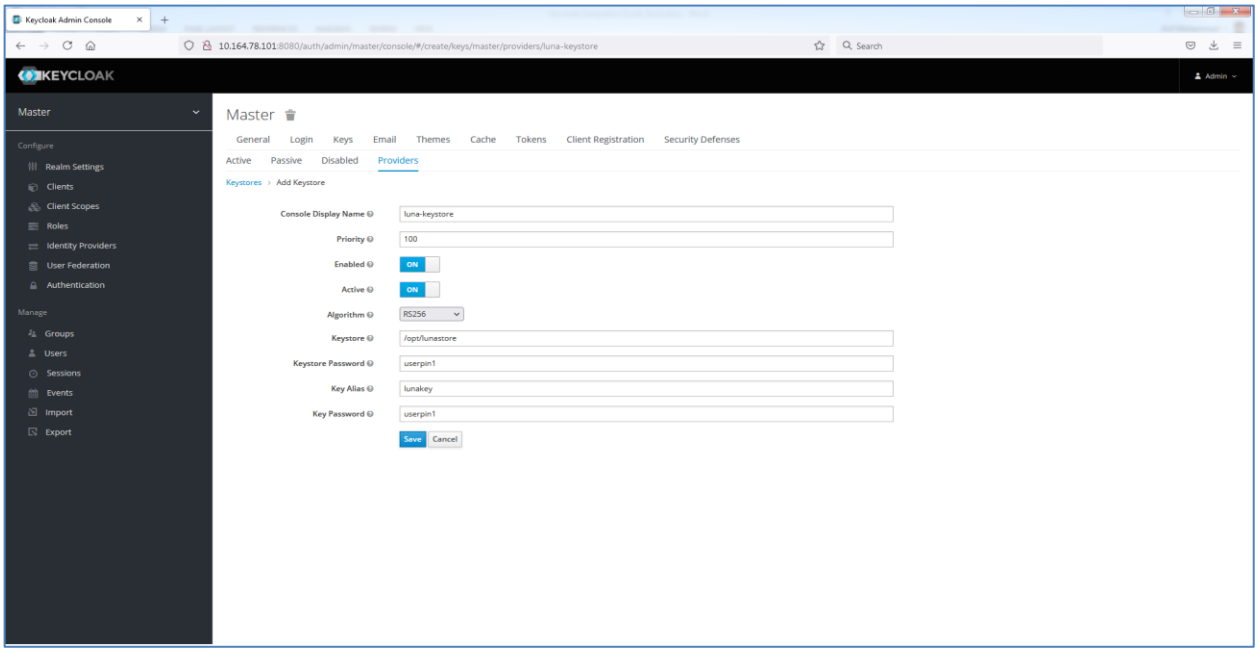
   Priority = 100

   Keystore = Path to lunastore file

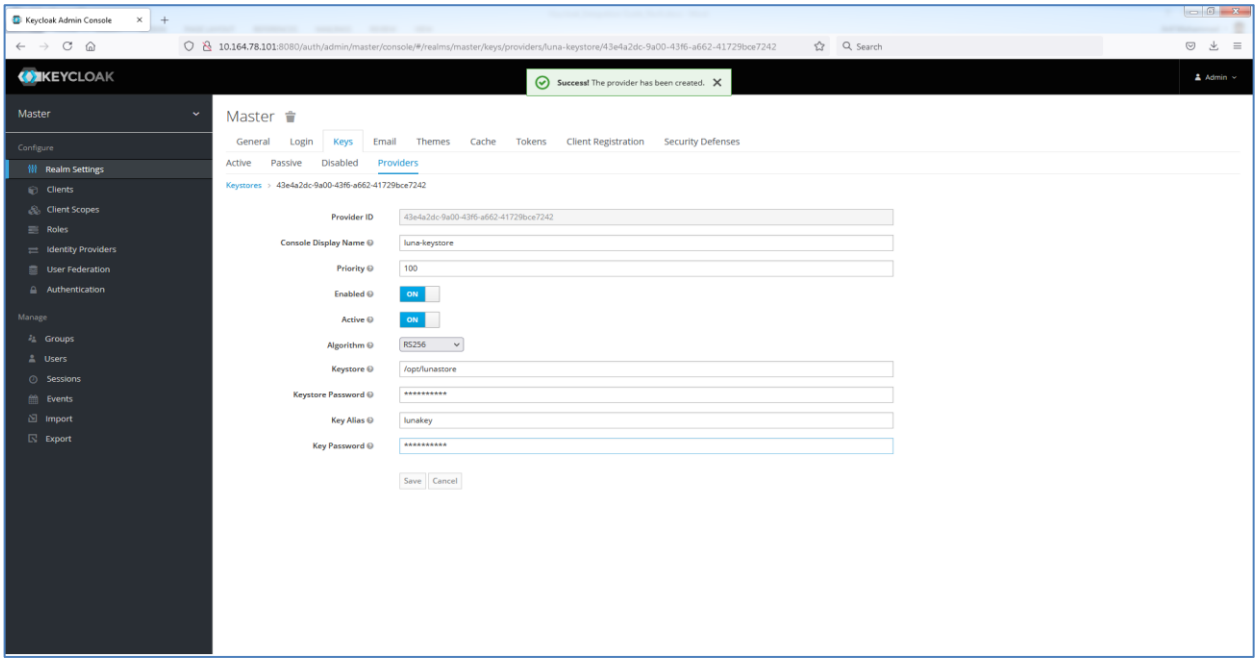
   KeyStore Password = Partition CO password

   Key Alias = Label of the key generated on Luna HSM

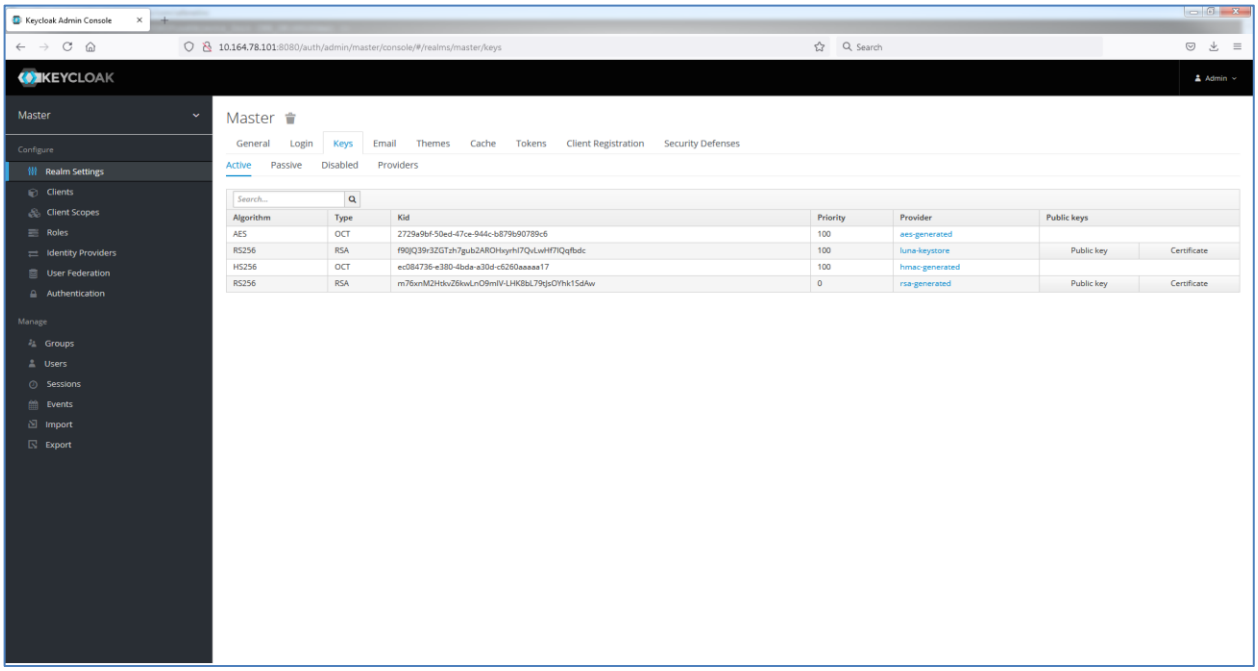
   Key Password = key password set while generating the key pair



You will see the following message when the provider has been created:



5. Navigate to **Realm Settings** > **Keys** and verify that **luna-keystore** Provider key is listed with the highest priority (100) in the list.



6. Stop and start the Keycloak server again and log in to the Keycloak admin console.

```
# /opt/keycloak/bin/standalone.sh
```

For every login session, token will be signed by Luna HSM generated key. You can now create User, Roles, and Client and when you generate the Authentication Token, it will be signed by Realm Signing Key available on the HSM.

If your Luna HSM is not available or if the NTLS is not running, you will not able to login to admin console because Keycloak will not get the signing keys from Luna HSM. This completes the integration of Keycloak with Luna HSM, enabling you to securely store the signing key and certificate on the Luna HSM.

Configuring Keycloak Container to use Luna HSM

This section demonstrates the steps required for generating signing keys and certificate on Luna HSM and configuring the Keycloak container to use the HSM generated key for token signing and XML document signing. Install and configure the Luna Client to use Luna HSM partition on the system where Keycloak container needs to be created. Configuring the Keycloak container involves the following steps:

> Set up Docker Environment

> Configure Java for Luna Keystore

> Generate signing keys and certificate on Luna Keystore

> Configure Keycloak container to use keys from Luna HSM

Set up Docker Environment

To set up Docker environment required to run the Keycloak container:

1. Install Docker and Docker Compose on the host system by following the instructions available in the Docker documentation:
   - Docker Installation: https://docs.docker.com/engine/install/
   - Docker Compose Installation: https://docs.docker.com/compose/install/
2. Add the user to `docker` group so that `sudo` is not required to run further commands:

```
# sudo gpasswd -a $USER docker
# addgroup docker
```

Configure Java for Luna Keystore

Follow the steps to Configure Java for Luna Keystore.

Generate signing keys and certificate on Luna Keystore

Follow the steps to Generate signing keys and certificate on Luna Keystore.

Configure Keycloak container to use keys from Luna HSM

Keycloak provides container images that can be configured to use Luna HSM in container and access the signing keys from Luna HSM using the Luna Provider and Keycloak Luna plugin. Follow the steps provided below on the host system having Docker environment and Luna Client configured to use the HSM partition.

1. Create a working directory on the host that will be used to store all configuration files required for running container with Luna HSM.

```
# mkdir /luna-docker
# cd /luna-docker
```

2. Pull the Keycloak image from Docker registry or from other registry that hosts official Keycloak images.

   ```
   # docker pull jboss/keycloak:15.0.2
   ```

3. Run the following command to boot Keycloak Server Docker image in the standalone mode.

   ```
   # docker run --name myKeyCloak -e DB_VENDOR=h2 -d jboss/keycloak:15.0.2
   ```

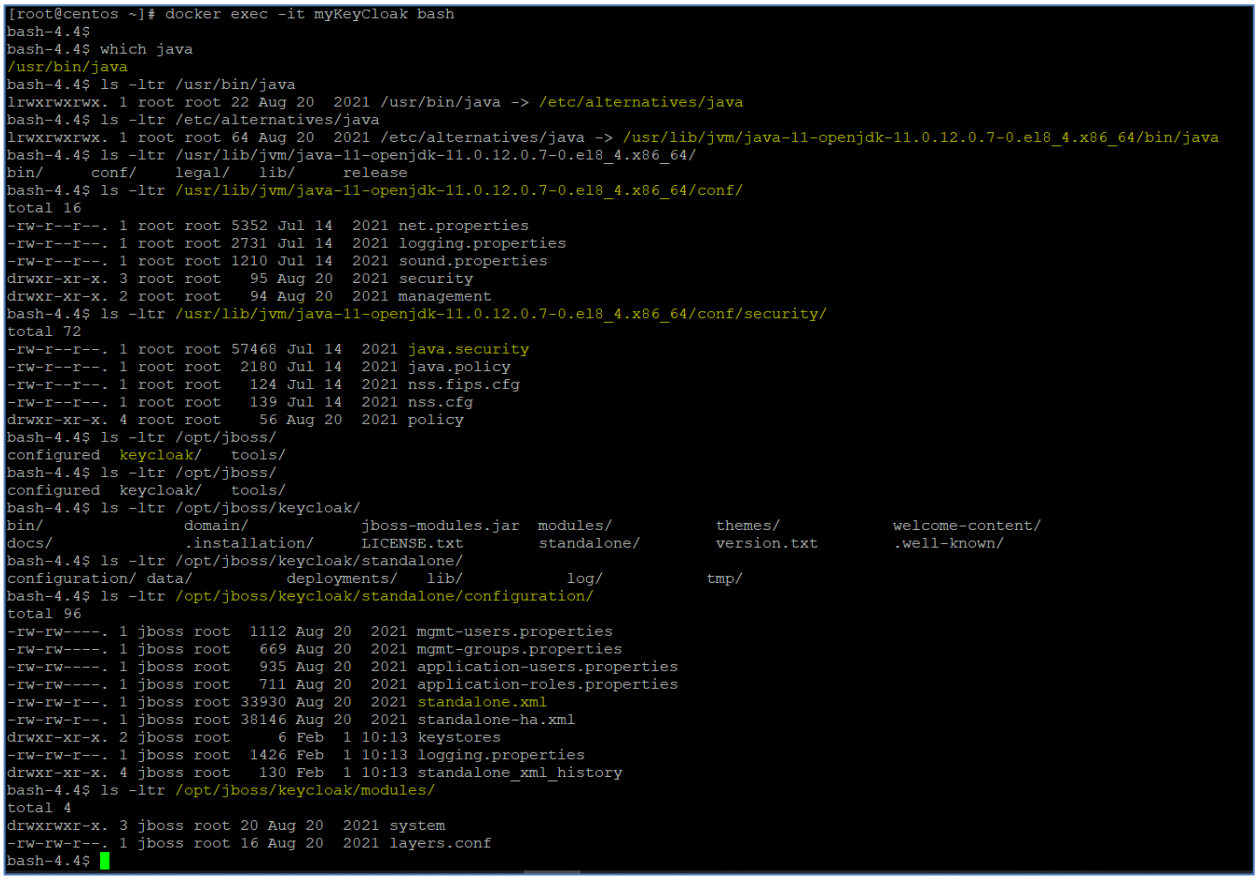
4. Launch the shell from running container to get the following details:

   a. Java version and `java.security` file location.

   b. Keycloak server configuration file – `standalone-ha.xml`.

   c. Path of the Keycloak server modules directory inside the container.

   ```
   # docker exec -it myKeyCloak bash
   ```



   As shown in the image, the contents under the container are as follows:

   a. Java Version – `JDK11`

   b. Location of java.security - `/usr/lib/jvm/java-11-openjdk-11.0.12.0.7-0.el8_4.x86_64/conf/security/`

   c. Location of standalone-ha.xml – as `standalone-ha.xml` is the default configuration for container `/opt/jboss/keycloak/standalone/configuration/standalone-ha.xml`

   d. Keycloak Modules directory - `/opt/jboss/keycloak/modules/`

   The information collected here will be used later when the Keycloak container is configured to use Luna HSM.

5. Exit from the container and copy the `java.security` and `standalone-ha.xml` file from the Keycloak container to `/luna-docker` directory. The location of the file provided in command should be the absolute path of the files inside the container obtained in step 4.

```
# docker cp myKeyCloak:/usr/lib/jvm/java-11-openjdk-11.0.12.0.7-
0.el8_4.x86_64/conf/security/java.security /luna-docker/
```

```
# docker cp
myKeyCloak:/opt/jboss/keycloak/standalone/configuration/standalone-ha.xml
/luna-docker/
```

6. Open the `java.security` file copied from container in file editor and update the provider list, depending on the JDK version inside the container. After updating the provider list, save the file.

```
# vi java.security
```

For JDK 11:

```
security.provider.1=SUN
security.provider.2=SunEC
security.provider.3=SunJSSE
security.provider.4=SunJCE
security.provider.5=SunJGSS
security.provider.6=SunSASL
security.provider.7=XMLDSig
security.provider.8=SunPCSC
security.provider.9=JdkLDAP
security.provider.10=JdkSASL
security.provider.11=SunPKCS11
security.provider.12=com.safenetinc.luna.provider.LunaProvider
security.provider.13=SunRsaSign
```

For JDK 8:

```
security.provider.1=sun.security.provider.Sun
security.provider.2=sun.security.rsa.SunRsaSign
security.provider.3=sun.security.ec.SunEC
security.provider.4=com.sun.net.ssl.internal.ssl.Provider
security.provider.5=com.sun.crypto.provider.SunJCE
security.provider.6=sun.security.jgss.SunProvider
security.provider.7=com.sun.security.sasl.Provider
security.provider.8=org.jcp.xml.dsig.internal.dom.XMLDSigRI
security.provider.9=sun.security.smartcardio.SunPCSC
security.provider.10=com.safenetinc.luna.provider.LunaProvider
```

7. Open the Keycloak configuration file `standalone-ha.xml` copied from container to add the Provider and SPI details, as follows:

```
# vi standalone-ha.xml
```

```
<provider>
    module:com.safenetinc.luna.keycloak.provider
</provider>
 .
 .
 <spi name="keys">
      <provider name="luna-keystore" enabled="true"/>
 </spi>
```

You need to mention the provider and SPI details above in the Provider and SPI sections already present in the XML file. Also ensure that `luna-keystore` is the first SPI in the list.

```
<web-context>auth</web-context>
<providers>
    <provider>
        classpath:${jboss.home.dir}/providers/*
    </provider>
    <provider>
        module:com.safenetinc.luna.keycloak.provider
    </provider>
</providers>
<master-realm-name>master</master-realm-name>
<scheduled-task-interval>900</scheduled-task-interval>
<theme>
    <staticMaxAge>2592000</staticMaxAge>
    <cacheThemes>true</cacheThemes>
    <cacheTemplates>true</cacheTemplates>
    <welcomeTheme>${env.KEYCLOAK_WELCOME_THEME:keycloak}</welcomeTheme>
    <default>${env.KEYCLOAK_DEFAULT_THEME:keycloak}</default>
    <dir>${jboss.home.dir}/themes</dir>
</theme>
<spi name="keys">
     <provider name="luna-keystore" enabled="true"/>
</spi>
<spi name="eventsStore">
    <provider name="jpa" enabled="true">
        <properties>
            <property name="exclude-events" value="[&quot;REFRESH_TOKEN&quot;]"/>
        </properties>
    </provider>
```

8. Change the ownership of the Luna Client that is installed on the host system to make it compatible for the Keycloak container as container is running using non-root user and there is no `hsmusers` group inside the container.

```
# chown -R root:root /etc/Chrystoki.conf
# chown -R root:root /usr/safenet/lunaclient/cert
# chown -R root:root /usr/safenet/lunaclient/data
# chown -R root:root /usr/safenet/lunaclient/configData
```

9. Extract the Keycloak Luna Plugin patch and copy the Keycloak Luna Plugin zip file (extracted from the patch) to the `/luna-docker` directory.

```
# tar -xvf 630-000621-001_SW_Patch_keycloak_integration_Custom_Release.tar
# cp 630-000621-001_SW_Patch_keycloak_integration_Custom_Release/keycloak-spi-luna-keystore-1.0-assemblyModule.zip /luna-docker/
```

For Keycloak 15 onwards:

```
# cp 630-000621-001_SW_Patch_keycloak_integration_Custom_Release/keycloak-spi-luna-keystore-1.1-assemblyModule.zip /luna-docker/
```

10. Traverse to the `/luna-docker` directory and extract the plugin zip file.

```
# cd /luna-docker
# unzip keycloak-spi-luna-keystore-1.0-assemblyModule.zip
```

For Keycloak 15 onwards:

```
# unzip keycloak-spi-luna-keystore-1.1-assemblyModule.zip
```

```
[root@centos luna-docker]# unzip keycloak-spi-luna-keystore-1.1-assemblyModule.zip
Archive:  keycloak-spi-luna-keystore-1.1-assemblyModule.zip
   creating: com/
   creating: com/safenetinc/
   creating: com/safenetinc/luna/
   creating: com/safenetinc/luna/keycloak/
   creating: com/safenetinc/luna/keycloak/provider/
  inflating: com/safenetinc/luna/keycloak/provider/module.xml
  inflating: com/safenetinc/luna/keycloak/provider/keycloak-spi-luna-keystore-1.1.jar
```

11. Traverse to the `com/safenetinc/luna` directory and create a `main/lib/linux-x86_64` folder under the `com\safenetinc\luna` directory.

```
# cd com/safenetinc/luna/
# mkdir -p main/lib/linux-x86_64
```

12. Copy the `LunaProvider.jar` file to the `main` folder created under the `com\safenetinc\luna` directory.

```
# cp <Luna_installation_directory>/jsp/lib/LunaProvider.jar main/
```

13. Copy `libLunaAPI.so` file to the `main/lib/linux-x86_64` directory created under the `com\safenetinc\luna` directory.

```
# cp <Luna_installation_directory>/jsp/lib/libLunaAPI.so main/lib/linux-x86_64
```

14. Create a file `module.xml` in the `main` folder and add the following information in it.

```
# cd main
# vi module.xml
```

```
<module name="com.safenetinc.luna"
xmlns="urn:jboss:module:1.9">
  <resources>
    <resource-root path="LunaProvider.jar"/>
```

```
    </resources>
    <dependencies>
     <module name="java.logging"/>
    </dependencies>
  </module>
```

15. Ensure that the `LunaProvider.jar`, `module.xml`, and `lib/linux-x86_64/libLunaAPI.so` files are present in the `/luna-docker/com/safenetinc/luna/main` directory that you've created.

```
[root@centos main]# ls -ltr /luna-docker/com/safenetinc/luna/main
total 652
drwxr-xr-x. 3 root root     26 Feb  2 19:58 lib
-rw-r--r--. 1 root root 660512 Feb  2 20:01 LunaProvider.jar
-rw-r--r--. 1 root root    218 Feb  2 20:03 module.xml
[root@centos main]# ls -ltr /luna-docker/com/safenetinc/luna/main/lib/linux-x86_64/
total 484
-rw-r--r--. 1 root root 492032 Feb  2 20:02 libLunaAPI.so
[root@centos main]#
```

16. Traverse to the `com/safenetinc/luna/keycloak/provider` directory created in the `/luna-docker` directory.

```
# cd /luna-docker/com/safenetinc/luna/keycloak/provider/
```

17. Create a `main` folder under the `com/safenetinc/luna/keycloak/provider` directory.

```
# mkdir main
```

18. Move the `keycloak-spi-luna-keystore-1.0.jar` and `module.xml` to the `main` directory.

```
# mv keycloak-spi-luna-keystore-1.0.jar module.xml main/
```

For Keycloak 15 onwards:

```
# mv keycloak-spi-luna-keystore-1.1.jar module.xml main/
```

19. Ensure that the `keycloak-spi-luna-keystore-x.x.jar` and `module.xml` files are present in the `/luna-docker/com/safenetinc/luna/keycloak/provider/main` directory that you've created.

    Where `x.x` is the version depending upon the Keycloak version used.

```
[root@centos provider]# ls -ltr /luna-docker/com/safenetinc/luna/keycloak/provider/main
total 16
-rw-r--r--. 1 root root  752 May 19  2022 module.xml
-rw-r--r--. 1 root root 9948 May 25  2022 keycloak-spi-luna-keystore-1.1.jar
[root@centos provider]#
```

20. Ensure that the `module.xml` file has the following content, including the name of the Plugin jar file.

> **NOTE:** For Keycloak v15.x onwards, ensure that "`keycloak-spi-luna-keystore-1.1.jar`" is used.

```
<?xml version='1.0' encoding='UTF-8'?>
<module xmlns="urn:jboss:module:1.3" name="com.safenetinc.luna.keycloak.provider" slot="main">
    <resources>
        <resource-root path="keycloak-spi-luna-keystore-1.1.jar"/>
    </resources>
    <dependencies>
        <module name="org.keycloak.keycloak-server-spi" services="import"/>
        <module name="org.keycloak.keycloak-server-spi-private" services="import"/>
        <module name="org.keycloak.keycloak-core"/>
        <module name="org.keycloak.keycloak-common"/>
        <module name="org.keycloak.keycloak-services"/>
        <module name="org.jboss.resteasy.resteasy-jaxrs"/>
        <module name="org.jboss.logging"/>
        <module name="com.safenetinc.luna"/>
    </dependencies>
</module>
```

21. Now go back to `/luna-docker` directory to ensure that you have the `java.security`, `standalone-ha.xml`, `lunastore` files and `com` directory.

```
# cd /luna-docker && ls -ltr
```

```
[root@centos luna-docker]# ls -ltr /luna-docker/
total 116
drwxr-xr-x. 3 root root    24 May 25  2022 com
-rw-r--r--. 1 root root 57531 Feb  2 19:23 java.security
-rw-r--r--. 1 root root  9485 Feb  2 19:55 keycloak-spi-luna-keystore-1.1-assemblyModule.zip
-rw-rw-r--. 1 root root 38380 Feb  6 12:59 standalone-ha.xml
-rw-r--r--. 1 root root    17 Feb  6 14:22 lunastore
[root@centos luna-docker]#
```

22. Ensure that `myKeyCloak` container is not running. Otherwise, stop and remove the container and then run it again to configure it with Luna HSM generated keys. In case you don't want to stop and remove the running container, you can run it with another name.

```
# docker ps -a
```

```
[root@centos luna-docker]# docker ps -a
CONTAINER ID   IMAGE                  COMMAND                  CREATED      STATUS      PORTS                NAMES
0167cea492d8   jboss/keycloak:15.0.2  "/opt/jboss/tools/do…"   2 days ago   Up 2 days   8080/tcp, 8443/tcp   myKeyCloak
```

```
# docker stop myKeyCloak
```

```
# docker rm myKeyCloak
```

23. Run the container again by providing all required details for Keycloak to get the keys from Luna HSM partition. The required details for getting the keys form Luna HSM are listed below:

a. `LunaClient` – mount the lunaclient folder.

b. `Chrystoki.conf` – mount the Luna Client Configuration file.

c. `lunastore` – luna keystore file containing Luna HSM partition.

d. `java.security` – mount the java configuration file where you enabled the Luna Provider

e. `standalone-ha.xml` – mount keycloak configuration file where you enabled Luna Provider and SPI

f. `Luna Keycloak Plugin` – mount the com folder where you extracted the Luna Keycloak plugin and configured it as Keycloak module.

Ensure that `java.security` and `standalone-ha.xml` files are mounted at the exact location where they are present inside Keycloak image. Mount `Luna Keycloak Plugin` in the Keycloak modules directory inside the container.

Refer to step 4 for the exact location of all the mounted contents inside the Keycloak container. Container can be up either using Docker command-line or by using YAML file.

i. Up the container using `docker run` command by providing all the required details in the command-line.

```
# docker run --name myKeyCloak -p 8443:8443 -p 8080:8080 -e
KEYCLOAK_USER=admin -e KEYCLOAK_PASSWORD=admin -e DB_VENDOR=h2 -v
/usr/safenet/lunaclient:/usr/safenet/lunaclient -v
/etc/Chrystoki.conf:/etc/Chrystoki.conf -v /luna-
docker/lunastore:/opt/lunastore -v /luna-
docker/java.security:/usr/lib/jvm/java-11-openjdk-11.0.12.0.7-
0.el8_4.x86_64/conf/security/java.security -v /luna-docker/standalone-
ha.xml:/opt/jboss/keycloak/standalone/configuration/standalone-ha.xml
-v /luna-docker/com:/opt/jboss/keycloak/modules/com -d
jboss/keycloak:15.0.2
```

Where `8080` and `8443` are the port for http and https respectively and login credentials are provided via `KEYCLOAK_USER` and `KEYCLOAK_PASSWORD`.

ii. Alternatively, up the container using the below YAML file.

```
# docker-compose up &
```

Where the contents of `compose.yaml` should be similar to the following:

```
services:
  myKeyCloak:
    container_name: myKeyCloak
    image: jboss/keycloak:15.0.2
    ports:
      - "8080:8080"
      - "8443:8443"
    environment:
      - KEYCLOAK_USER=admin
      - KEYCLOAK_PASSWORD=admin
      - DB_VENDOR=h2
    volumes:
      - /usr/safenet/lunaclient:/usr/safenet/lunaclient
      - /etc/Chrystoki.conf:/etc/Chrystoki.conf
```

```
        - /luna-docker/lunastore:/opt/lunastore
        - /luna-docker/com:/opt/jboss/keycloak/modules/com
        - /luna-docker/java.security:/usr/lib/jvm/java-11-openjdk-
11.0.12.0.7-0.el8_4.x86_64/conf/security/java.security
        - /luna-docker/standalone-
ha.xml:/opt/jboss/keycloak/standalone/configuration/standalone-
ha.xml
```

24. Ensure that the container is up and running with **luna-keystore** configured. Inspect the container logs to see the Keycloak service are running with luna-keystore and SPI enabled in `standalone-ha.xml` file.

    ```
    # docker logs myKeyCloak | grep luna
    ```

    A message similar to the following would appear in the logs:

    ```
    07:31:52,410 WARN [org.keycloak.services] (ServerService Thread Pool --62)
    KC-SERVICES0047: luna-keystore
    (com.safenetinc.luna.keycloak.provider.LunaKeystoreProviderFactory) is
    implementing the internal SPI keys. This SPI is internal and may change
    without notice
    ```

    ```
    [root@centos luna-docker]# docker logs myKeyCloak | grep luna
    WARNING: An illegal reflective access operation has occurred
    WARNING: Illegal reflective access by org.wildfly.extension.elytron.SSLDefinitions (jar:file:/opt/jboss/keycl
    oak/modules/system/layers/base/org/wildfly/extension/elytron/main/wildfly-elytron-integration-15.0.1.Final.ja
    r!/) to method com.sun.net.ssl.internal.ssl.Provider.isFIPS()
    WARNING: Please consider reporting this to the maintainers of org.wildfly.extension.elytron.SSLDefinitions
    WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operations
    WARNING: All illegal access operations will be denied in a future release
    07:31:52,410 WARN  [org.keycloak.services] (ServerService Thread Pool -- 66) KC-SERVICES0047: luna-keystore (
    com.safenetinc.luna.keycloak.provider.LunaKeystoreProviderFactory) is implementing the internal SPI keys. Thi
    s SPI is internal and may change without notice
    [root@centos luna-docker]#
    ```

25. Log in to admin console using the port that you mapped while running the container. The URL for the Admin Console would be: https://<hostname_or_ip>:8443.

26. Log in to admin console and follow the steps to Configure Keycloak to use signing keys from Luna Keystore

27. After configuring the Keycloak container to use Luna HSM generated key, restart the container as follows.

    If using command-line:

    ```
    # docker stop myKeyCloak
    ```

    ```
    # docker start myKeyCloak
    ```

    If using YAML file:

    ```
    # docker-compose restart &
    ```

After the container is up, Keycloak running inside the container will use the keys generated on Luna HSM.

This completes the Luna HSM integration with Keycloak container.

Contacting Customer Support

If you encounter a problem while installing, registering, or operating this product, 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.

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