JAVA KEYTOOL

Integration Guide

Applicable Devices:
Vectera Plus

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[1] DOCUMENT INFORMATION

[1.1] DOCUMENT OVERVIEW

The purpose of this document is to provide information regarding Java Keytool integration with Futurex HSMs. For additional questions related to your HSM, see the relevant user guide or reach out to a Solutions Architect for help.

[1.1.1] About Keytool Integration

Keytool is a Java program that allows Java application developers to obtain and manage CA certificates for authentication and digital signing, along with the KeyStore of keys and certificate chains. Java Keytool integration with Futurex HSMs is made simple by the PKCS #11 library. For added hardware-backed security, Keytool supports integration with HSMs for managing the key lifecycle in a FIPS-140 Level 3 cryptographic boundary.

[1.2] COPYRIGHT AND TRADEMARK NOTICES

[1.3] TERMS OF USE

[2] OUR STORY

For over 40 years, Futurex has been a globally recognized provider of scalable, versatile, and secure data protection solutions for organizations worldwide. More than 15,000 customers have trusted Futurex's innovative Hardened Enterprise Security Platform to provide market-leading solutions for the secure encryption, storage, transmission, and certification of sensitive data. Futurex maintains an unyielding commitment to offering advanced, standards-compliant solutions, including:

- Hardware security modules for cryptographic data processing
- Enterprise key, certificate, and token lifecycle management
- Remote key management and injection platforms
- Secure, hand-held devices for configuration, management, and compliant key loading
- High availability solutions for centralized configuration, management, monitoring, load balancing, and disaster recovery
- Secure storage and access of sensitive data
- Customizable data encryption solutions that meet users' specific needs

In understanding the diverse needs of our customers, we actively maintain and develop our expertise across multiple disciplines including hardware design and development, software and firmware engineering, regulatory compliance and certification, enterprise architecture design, and technical support. This drives our success and enables us to reach organizations of every size and industry. The cryptographic environments developed by our Solutions Architects incorporate Futurex technology and VirtuCrypt cloud-based services exclusively, with zero reliance on third-party software or hardware. By directly overseeing all aspects of development and production of our technology, we maintain the agility and knowledge necessary to support complex customer environments where solutions grow alongside their business.

Throughout every facet of our organization, we maintain a focus on providing exceptional customer service, best-in-class technology, and effective solutions for our customers. The continuous expansion of our innovative products and services exhibits our dedication to meeting the growing business needs of our global customers and partners. Through our results-oriented engineering culture, we have provided organizations worldwide with custom solutions supporting aggressive times to market.

Our products satisfy the most rigorous security requirements, proving our unyielding dedication to the standards-based security of our enterprise-class solutions. As we move forward, Futurex will continue to be a global leader in the data security and electronic transaction industries by maintaining high performance standards, providing quality service, and expanding our best-in-class product suite.

[3] PREREQUISITES

Supported Hardware:

- Vectera Plus, 6.7.x.x and above

Supported Operating Systems:

- Windows 7 and above
- Linux (Ubuntu, Debian and Red Hat-based distributions)

Other:

- Java 7, 8, or 9
- OpenSSL

[4] INSTALL FUTUREX PKCS #11 (FXPKCS11)

In a Windows environment, the easiest way to install the PKCS #11 module is by using **FXTools**. FXTools can be downloaded from the Futurex Portal. In a Linux environment, you need to download a tarball of the PKCS #11 binaries from the Futurex Portal. Then, extract the *.tar* file locally where you want the application to be installed in your file system. Step by step installation instructions for both of these scenarios is provided in the following subsections.

[4.1] INSTRUCTIONS FOR INSTALLING THE PKCS #11 MODULE USING FXTOOLS IN WINDOWS

- Run the FXTools installer as an administrator

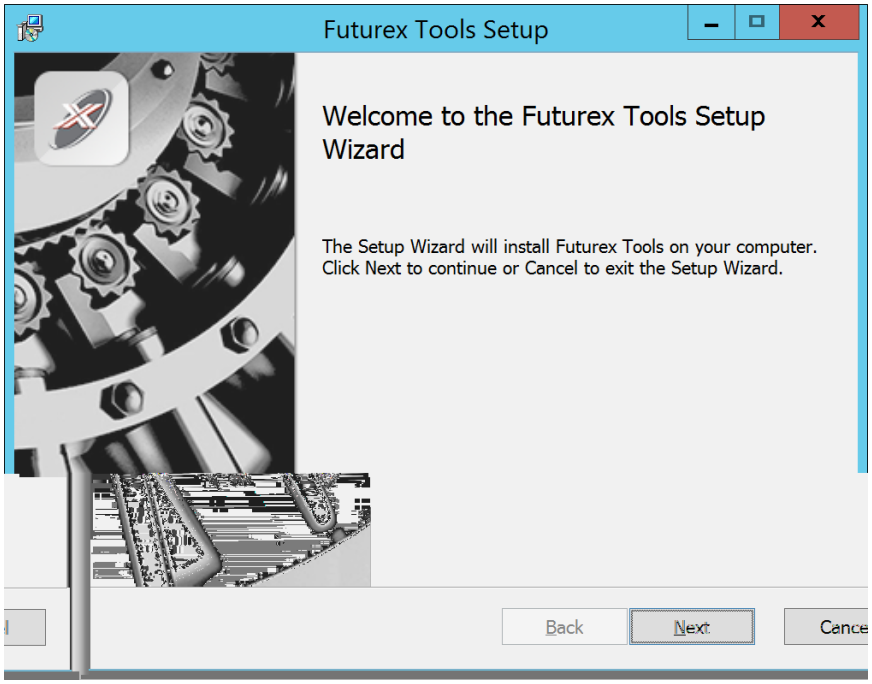


FIGURE: FUTUREX TOOLS SETUP WIZARD

By default, all tools are installed on the system. A user can overwrite and choose not to install certain modules.

- **Futurex Client Tools –** Command Line Interface (CLI) and associated SDK for both Java and C.
- **Futurex CNG Module –** The Microsoft Next Generation Cryptographic Library.
- **Futurex Cryptographic Service Provider (CSP) –** The legacy Microsoft cryptographic library.
- **Futurex EKM Module –** The Microsoft Enterprise Key Management library.
- **Futurex PKCS #11 Module –** The Futurex PKCS #11 library and associated tools.
- **Futurex Secure Access Client –** The client used to connect a Futurex Excrypt Touch to a local laptop, via USB, and a remote Futurex device.

After starting the installation, all noted services are installed. If the Futurex Secure Access Client was selected, the Futurex Excrypt Touch driver will also be installed (Note this sometimes will start minimized or in the background).

After installation is complete, all services are installed in the "*C:\Program Files\Futurex*" directory. The CNG Module, CSP Module, EKM Module, and PKCS #11 Module all require configuration files, located in their corresponding directory with a *.cfg* extension. In addition, the CNG and CSP Modules are registered in the Windows Registry (*HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Cryptography\Defaults\Provider*) and are installed in the "*C:\Windows\System32*" directory.

[4.2] INSTRUCTIONS FOR INSTALLING THE PKCS #11 MODULE IN LINUX

Extract the appropriate tarball file for your specific Linux distribution in the desired working directory.

NOTE: For the Futurex PKCS #11 module to be accessible system-wide, it would need to be placed into */usr/local/bin* by an administrative user. If the module only needs to be utilized by the current user, then installing into *$HOME/bin* would be the appropriate location.

The extracted content of the *.tar* file is a single *fxpkcs11* directory. Inside of the *fxpkcs11* directory are the following files and directories (Only files/folders that are relevant to the installation process are included below):

- *fxpkcs11.cfg* -> PKCS #11 configuration file
- *x86/* - This folder contains the module files for 32-bit architecture
- *x64/* - This folder contains the module files for 64-bit architecture

Within the *x86* and *x64* directories are two directories. One named *OpenSSL-1.0.x* and the other named *OpenSSL-1.1.x*. Both of these OpenSSL directories contain the PKCS #11 module files, built with the respective OpenSSL versions. These files are listed below, with short descriptions of each:

- *configTest* -> Program to test configuration and connection to the HSM
- *libfxpkcs11.so* -> PKCS #11 Library File
- *PKCS11Manager* -> Program to test connection and manage the HSM through the PKCS #11 library

The *configTest* and *PKCS11Manager* programs look for the *fxpkcs11.cfg* file at the following path:

```
/etc/fxpkcs11.cfg
```

Because of this, it is necessary either to move the *fxpkcs11.cfg* file from the */usr/local/bin/fxpkcs11* directory to the */etc* directory, or to set the FXPKCS11_CFG environment variable to point to the *fxpkcs11.cfg* file.

[5] INSTALL EXCRYPT MANAGER (IF USING WINDOWS)

Excrypt Manager is a Windows application that can be used to configure the HSM in subsequent sections. HSM configuration can also be completed using FXCLI, the Excrypt Touch, or the Guardian Series 3. For more information about using these tools/devices to configure the HSM, please see the relevant Administrator's Guide.

NOTE: If you plan to use a Virtual HSM for the integration, all configurations will need to be performed using either FXCLI, the Excrypt Touch, or the Guardian Series 3.

NOTE: The Excrypt Manager version must be from the 4.4.x branch or later to be compatible with the HSM firmware, which must be 6.7.x.x or later.

- Run the Excrypt Manager installer as an administrator.

The installation wizard will ask you to specify where you want Excrypt Manager to be installed. The default location is "*C:\Program Files\Futurex\Excrypt Manager*". Once that is done click "Install".

[6] INSTALL FUTUREX COMMAND LINE INTERFACE (FXCLI)

NOTE: Windows users can skip this step because FXCLI was included with the FXTools installation.

[6.1] INSTRUCTIONS FOR INSTALLING FXCLI IN LINUX

NOTE: These instructions are for Ubuntu-based Linux distributions. For instructions on how to install FXCLI on other Linux distributions, such as Debian or Red Hat, please see the relevant Administrator's guide.

Download the FXCLI module

The user must download the correct *.deb* package files from the Futurex Portal.

Below is the full list of *.deb* files for Ubuntu/Debian-based Linux distributions:

- fxcl-1.4.1-linux-amd64-ssl1.0-cli-fxparse.deb
- fxcl-1.4.1-linux-amd64-ssl1.0-cli-hsm.deb
- fxcl-1.4.1-linux-amd64-ssl1.0-cli-kmes.deb
- fxcl-1.4.1-linux-amd64-ssl1.0-devel.deb
- fxcl-1.4.1-linux-amd64-ssl1.0-java.deb
- fxcl-1.4.1-linux-amd64-ssl1.1-cli-fxparse.deb
- fxcl-1.4.1-linux-amd64-ssl1.1-cli-hsm.deb
- fxcl-1.4.1-linux-amd64-ssl1.1-cli-kmes.deb
- fxcl-1.4.1-linux-amd64-ssl1.1-devel.deb
- fxcl-1.4.1-linux-amd64-ssl1.1-java.deb
- fxcl-1.4.1-linux-i386-ssl1.0-cli-fxparse.deb
- fxcl-1.4.1-linux-i386-ssl1.0-cli-hsm.deb
- fxcl-1.4.1-linux-i386-ssl1.0-cli-kmes.deb
- fxcl-1.4.1-linux-i386-ssl1.0-devel.deb
- fxcl-1.4.1-linux-i386-ssl1.0-java.deb
- fxcl-1.4.1-linux-i386-ssl1.1-cli-fxparse.deb
- fxcl-1.4.1-linux-i386-ssl1.1-cli-hsm.deb
- fxcl-1.4.1-linux-i386-ssl1.1-cli-kmes.deb
- fxcl-1.4.1-linux-i386-ssl1.1-devel.deb
- fxcl-1.4.1-linux-i386-ssl1.1-java.deb

If the system is **64-bit**, users should select from the files marked **amd64**. If the system is **32-bit**, users should select from the files marked **i386**.

If running an OpenSSL version in the **1.0.x** branch, users should select from the files marked **ssl1.0**. If running an OpenSSL version in the **1.1.x** branch, users should select from the files marked **ssl1.1**.

Additionally, users can install the packages based on the desired features they wish to install. For example, if your cryptographic infrastructure does not have a KMES Series 3 device, it would not be necessary to download the files for **cli-kmes**.

Futurex offers the following features for FXCLI:

- Java Software Development Kit (**java**)
- HSM command line interface (**cli-hsm**)
- KMES command line interface (**cli-kmes**)
- Software Development Kit headers (**devel**)
- YAML parser used to parse bash output (**cli-fxparse**)

Install FXCLI

To install *.deb* packages on a Linux system, use the **apt** command. The following example uses the *.deb* package for a computer with a 64-bit processor, running an OpenSSL version in the 1.0.x branch, to install cli-hsm. Once you have downloaded the *.deb* file that you wish to install from the Futurex Portal, run the following command in a terminal:

```
$ sudo dpkg -i fxcl-1.4.1-linux-amd64-ssl1.0-cli-hsm.deb
```

NOTE: After the installation is completed, system environment variables must be defined for the location of the FXCLI binaries. To do so permanently you must add the following two lines to your *.bashrc* file:

```
PATH=$PATH:/usr/bin/fxcli-hsm
PATH=$PATH:/usr/bin/fxcli-kmes
```

[7] INSTALL FXJCE FILES

The Java provider relies on a JNI (Java Native Interface) library, which must be in the server's *$JAVA_HOME/jre/lib* directory. It also requires a provider, which should be saved in the *$JAVA_HOME/jre/lib/ext* directory.

Extract the files from the zip file (*fxjce-OperatingSystem_x.xx.zip*) corresponding to the operating system in the working folder. Examples for each operating system are below:

Linux:

libfxjp11.so (library) -> *$JAVA_HOME/jre/lib/ext*

sunpkcs11-fx.jar (extension) -> *$JAVA_HOME/jre/lib/ext*

Windows:

fxjp11.dll (library) -> *C:\Program Files\Java\jre\lib\ext*

sunpkcs11-fx.jar (extension) -> *C:\Program Files\Java\jre\lib\ext*

[8] SETTING SYSTEM ENVIRONMENT VARIABLES FOR THE JAVA LIBRARY

System environment variables must be defined for the location of the Java library. The variable settings are:

- JAVA_HOME = path to Java directory
- JRE_HOME = path to Java directory
- PATH = ; (add all the paths described above)

Windows example:

- JAVA_HOME = C:\Program Files\Java\jre1.8.0_211
- JRE_HOME = C:\Program Files\Java\jre1.8.0_211
- PATH = …; C:\Program Files\Java\jre1.8.0_211; C:\Program Files\Java\jre1.8.0_211\bin;

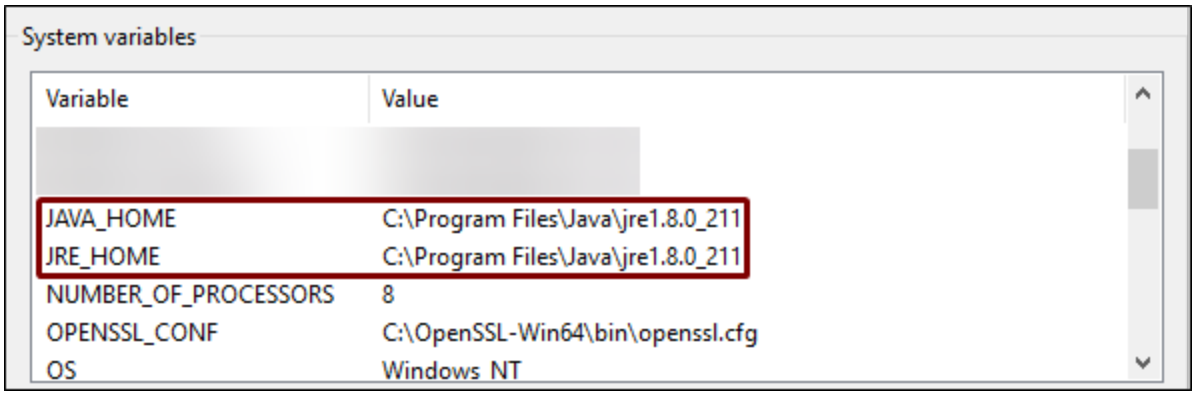


FIGURE: SAMPLE SYSTEM VARIABLE SETTINGS

Linux example:

To define a system environment variable for the location of the Java library in Linux, you need to add the following line to your **.bashrc file:** (**NOTE**: This may be slightly different depending on where the Java library is installed on your system.)

```
PATH=$PATH:/usr/lib/jvm/java-8-openjdk-amd64/jre/lib/ext
```

[9] REGISTERING THE JAVA PROVIDER

The Java provider must be registered before it can be used. To register, modify the *java.security* file on the system (typically located in *$JAVA_HOME/jre/lib/security*). Append a line similar to the following to the provider list in the *java.security* file:

```
security.provider.11=fx.security.pkcs11.SunPKCS11
```

FIGURE: SAMPLE JAVA.SECURITY FILE

[10] CONFIGURE THE FUTUREX HSM

In order to establish a connection between the PKCS #11 library and the Futurex HSM, a few configuration items need to first be performed, which are the following:

NOTE: All of the steps in this section can be completed through either Excrypt Manager or FXCLI (if using a physical HSM rather than a virtual HSM). Optionally, steps 4 through 6 can be completed through the Guardian Series 3, which will be covered in Appendix A.

1. Connect to the HSM via the front USB port (NOTE: If you are using a virtual HSM for the integration you will have to connect to it over the network either via FXCLI, the Excrypt Touch, or the Guardian Series 3)
    a. Connecting via Excrypt Manager
    b. Connecting via FXCLI
2. Validate the correct features are enabled on the HSM
3. Setup the network configuration
4. Load the Futurex FTK
5. Configure a Transaction Processing connection and create a new Application Partition
6. Create a new Identity that has access to the Application Partition created in the previous step
7. Configure TLS Authentication. There are two options for this:
    a. Enabling server-side authentication
    b. Creating client certificates for mutual authentication

Each of these action items is detailed in the following subsections.

[10.1] CONNECT TO THE HSM VIA THE FRONT USB PORT

For both Excrypt Manager and FXCLI you need to connect your laptop to the front USB port on the HSM.

Connecting via Excrypt Manager

Open Excrypt Manager, click “Refresh” in the lower right-hand side of the Connection menu. Then select “USB Connection” and click “Connect”.

Login with both default Admin identities.

The default Admin passwords (i.e. “safe”) must be changed for both of your default Admin Identities (e.g. “Admin1” and “Admin2”) in order to load the major keys onto the HSM.

To do so via Excrypt Manager navigate to the Identity Management menu, select the first default Admin identity (e.g. “Admin1”), then click the “Change Password…” button. Enter the old password, then enter the new password twice, and click “OK”. Perform the same steps as above for the second default Admin identity (e.g. “Admin2”).

Connecting via FXCLI

Open the FXCLI application and run the following commands:

```
$ connect usb
$ login user
```

NOTE: The "login" command will prompt for the username and password. You will need to run it twice because you must login with both default Admin identities.

The default Admin passwords (i.e. “safe”) must be changed for both of your default Admin Identities (e.g. “Admin1” and “Admin2”) in order to load the major keys onto the HSM.

The following FXCLI commands can be used to change the passwords for each default Admin Identity.

```
$ user change-password -u Admin1
$ user change-password -u Admin2
```

NOTE: The user change-password commands above will prompt you to enter the old and new passwords. It is necessary to run the command twice (as shown above) because the default password must be changed for both default Admin identities.

[10.2] FEATURES REQUIRED IN HSM

In order to establish a connection between the PKCS #11 Library and the Futurex HSM, the HSM must be configured with the following features:

- **PKCS #11** -> Enabled
- **Command Primary Mode** -> General Purpose (GP)

NOTE: For additional information about how to update features on your HSM, please refer to your HSM Administrator's Guide, section **"Download Feature Request File"**.

NOTE: Command Primary Mode = General Purpose, will enable the option to create the FTK major key in the HSM. This key will be required to be able to use the PKCS #11 library to communicate with the HSM. For detailed information about how to load major keys in HSMs please refer to your HSM Administrator's Guide.

[10.3] NETWORK CONFIGURATION (HOW TO SET THE IP OF THE HSM)

For this step you will need to be logged in with an identity that has a role with permissions ***Communication:Network Settings****. The default Administrator role and Admin identities can be used.*

Navigate to the *Configuration* page. There you will see the option to modify the IP configuration, as shown below:

Alternatively, the following **FXCLI** command can be used to set the IP for the HSM:

```
$ network interface modify --interface Ethernet1 --ip 10.221.0.10 --netmask 255.255.255.0 --gateway
10.221.0.1
```

NOTE: The following should be considered at this point:

- All of the remaining HSM configurations in this section can be completed using the Guardian Series 3 (please refer to Appendix A for instructions on how to do so), with the exception of the final subsection that covers how to create connection certificates for mutual authentication.
- If you are performing the configuration on the HSM directly now, but plan to add the HSM to a Guardian later, it may be necessary to synchronize the HSM after it is added to a Device Group on the Guardian.
- If configuration through a CLI is required for your use-case, then you should manage the HSMs directly.

[10.4] LOAD FUTUREX KEY (FTK)

For this step you will need to be logged in with an identity that has a role with permissions ***Major Keys:Load****. The default Administrator role and Admin identities can be used.*

The FTK is used to wrap all keys stored on the HSM used with PKCS #11. If using multiple HSMs in a cluster, the same FTK can be used for syncing HSMs. Before an HSM can be used with PKCS #11, it must have an FTK.

NOTE: This process can also be completed using FXCLI, the Excrypt Touch, or the Guardian Series 3. For more information about how to load the FTK into an HSM using these tools/devices, please see the relevant Administrative Guide.

After logging in, select *Key Management*, then "Load" under FTK. Keys can be loaded as components that are XOR'd together, M-of-N fragments, or generated. If this is the first HSM in a cluster, it is recommended to generate the key and save to smart cards as M-of-N fragments.

Alternatively, the following **FXCLI** commands can be used to load an FTK onto an HSM.

If this is the first HSM you are setting up you will need to generate a random FTK. Optionally, you can also load it onto smart cards simultaneously with the -m and -n flags.

```
$ majorkey random --ftk -m [number_from_2_to_9] -n [number_from_2_to_9]
```

If it's a second HSM that you're setting up in a cluster then you will load the FTK from smart cards with the following command:

```
$ majorkey recombine --key ftk
```

[10.5] CONFIGURE A TRANSACTION PROCESSING CONNECTION AND CREATE AN APPLICATION PARTITION

For this step you will need to be logged in with an identity that has a role with permissions ***Role:Add, Role:Assign All Permissions, Role:Modify, Keys:All Slots****, and* ***Command Settings:Excrypt****. The default Administrator role and Admin identities can be used.*

NOTE: For the purposes of this integration guide you can consider the terms "Application Partition" and "Role" to be synonymous. For more information regarding Application Partitions, Roles, and Identities, please refer to the relevant Administrator's guide.

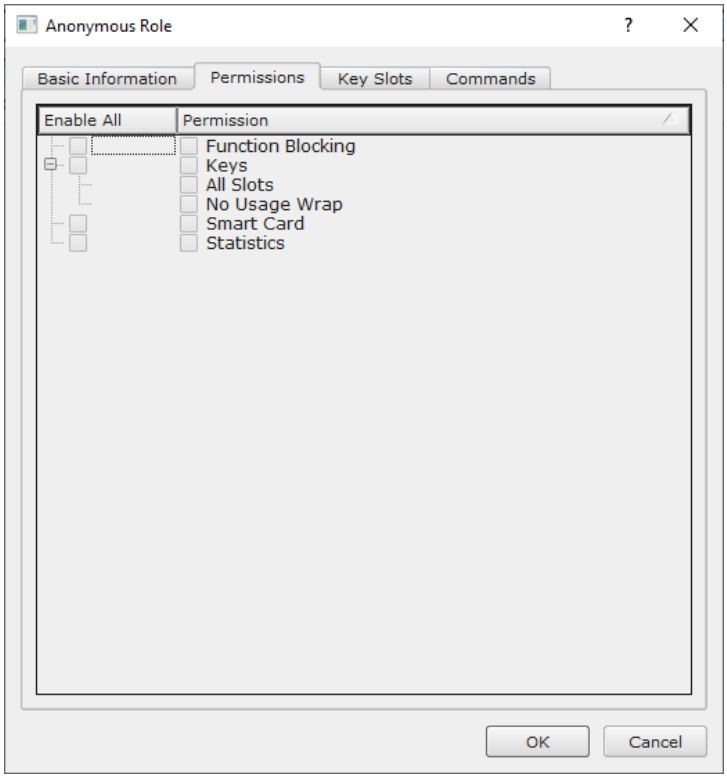
Configure a Transaction Processing Connection

Before an application logs in to the HSM with an authenticated user, it first connects via a “Transaction Processing” connection to the “Anonymous” Application Partition. For this reason, it is necessary to take steps to harden the “Anonymous” Application Partition. These three things need to be configured for the “Anonymous” partition:

1. It should not have access to the “All Slots” permissions
2. It should not have access to any key slots
3. Only the PKCS #11 communication commands should be enabled

Go to *Application Partitions*, select the “Anonymous” Application Partition, and click Modify.

Navigate to the "Permissions" tab and ensure that the “All Slots” key permission is unchecked. None of the other key permissions should be enabled either.



Under the "Key Slots" tab you need to ensure that there are no key ranges specified. By default, the Anonymous Application Partition has access to the entire range of key slots on the HSM.

Lastly, under the “Commands” tab make sure that only the following **PKCS #11 Communication commands** are enabled for the "Anonymous" Application Partition:

- **ECHO**: Communication Test/Retrieve Version
- **PRMD**: Retrieve HSM restrictions
- **RAND**: Generate random data
- **HASH**: Retrieve device serial
- **GPKM**: Retrieve key table information
- **GPKS**: General purpose key settings get/change
- **GPKR**: General purpose key settings get (read-only)

Alternatively, the following **FXCLI** commands can be used to remove all permissions and key ranges that are currently assigned to the “Anonymous” role and enable only the PKCS #11 Communication commands:

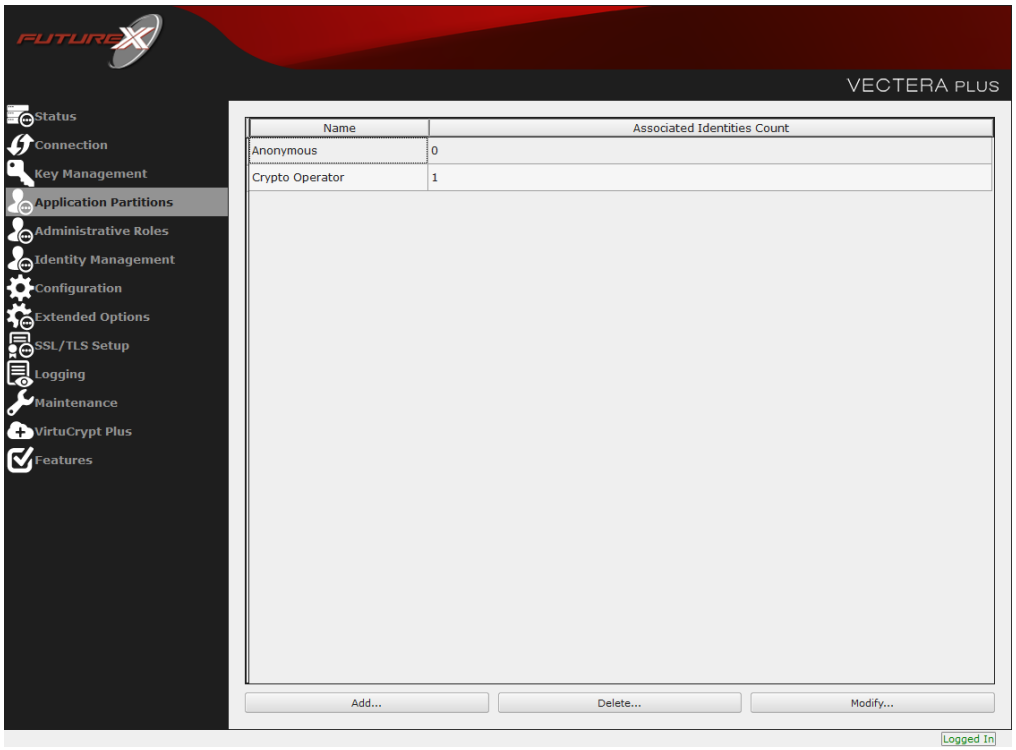
```
$ role modify --name Anonymous --clear-perms --clear-key-ranges
```

```
$ role modify --name Anonymous --add-perm Excrypt:ECHO --add-perm Excrypt:PRMD --add-perm Excrypt:RAND
--add-perm Excrypt:HASH --add-perm Excrypt:GPKM --add-perm Excrypt:GPKS --add-perm Excrypt:GPKR
```

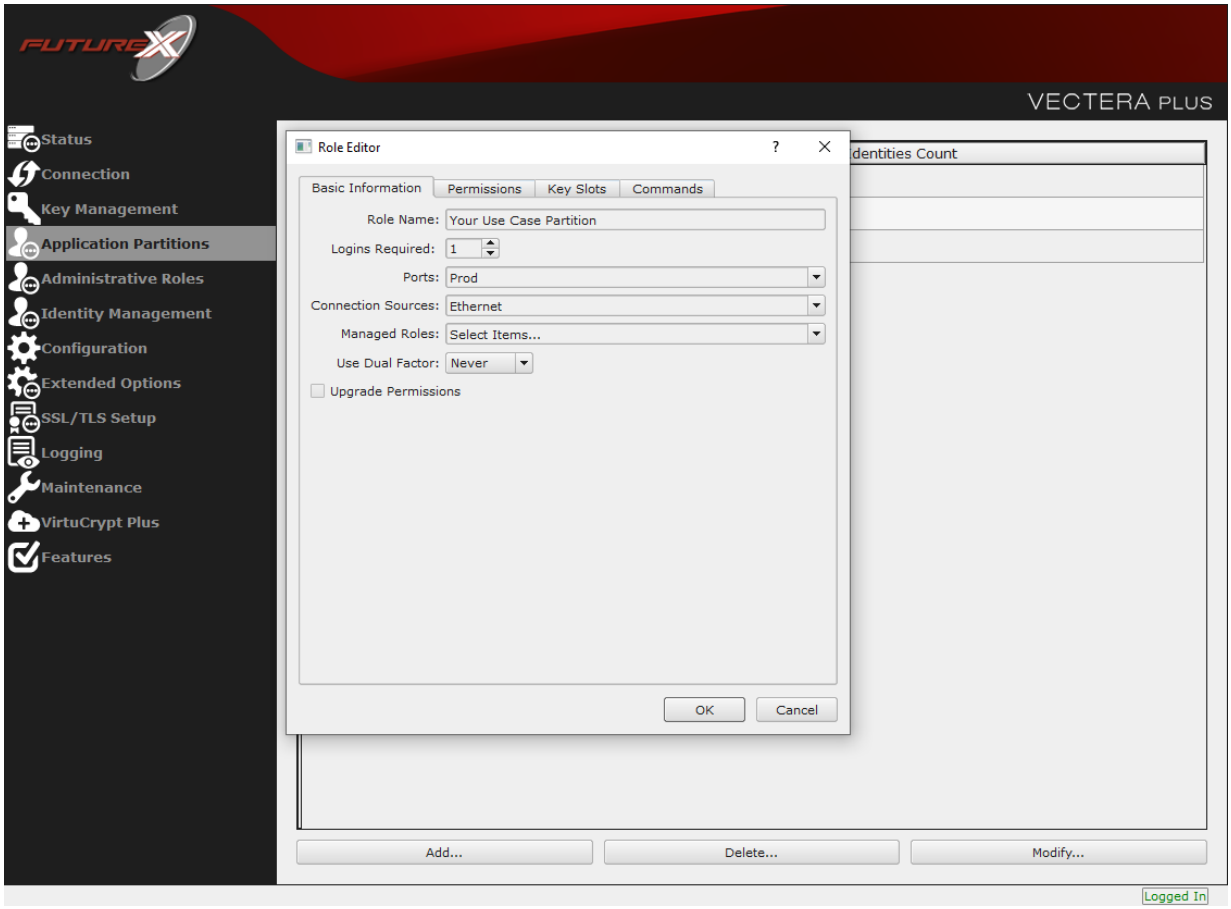
Create an Application Partition

In order for application segregation to occur on the HSM, an Application Partition must be created specifically for your use case. Application partitions are used to segment the permissions and keys on an HSM between applications. The process for configuring a new application partition is outlined in the following steps:

Navigate to the *Application Partitions* page and click the "Add" button at the bottom.

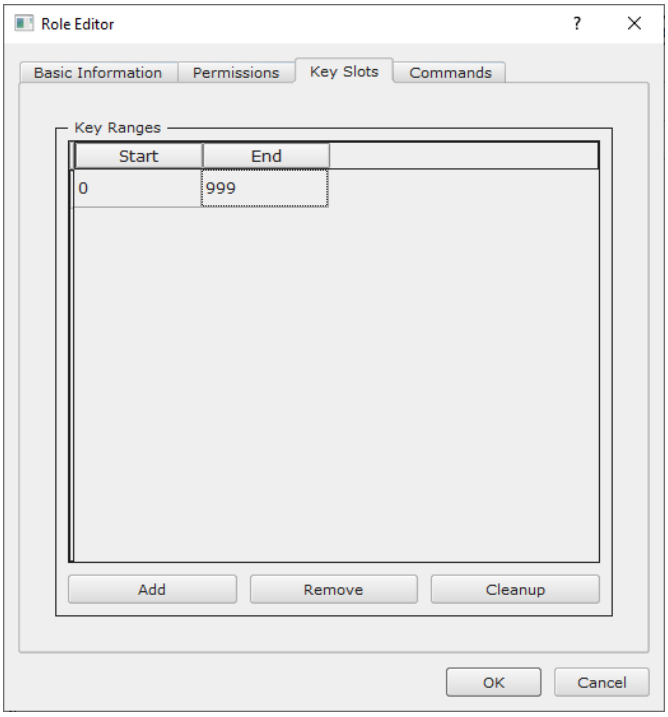


Fill in all of the fields in the *Basic Information* tab exactly how you see below (except for the *Role Name* field). In the *Role Name* field, specify any name that you would like for this new Application Partition. *Logins Required* should be set to "1". *Ports* should be set to "Prod". *Connection Sources* should be configured to "Ethernet". The *Managed Roles* field should be left blank because we'll be specifying the exact Permissions, Key Slots, and Commands that we want this Application Partition/Role to have access to. Lastly, the *Use Dual Factor* field should be set to "Never".



Under the "Permissions" tab, select the key permissions shown in the screenshot below. The **Authorized** permission allows for keys that require login. The **Import PKI** permission allows trusting an external PKI, which is used by some applications to allow for PKI symmetric key wrapping (It is not recommended to enable unless using this use case). The **No Usage Wrap** permission allows for interoperable key wrapping without defining key usage as part of the wrapped key (This is only recommended if exchanging keys with external entities or using the HSM to wrap externally used keys).

Under key slots, it is recommended that you create a range of 1000 total keys (here we've specified the key range 0-999), which do not overlap with another Application Partition. Within this range, there must be ranges for both symmetric and asymmetric keys. If more keys are required by the application, configure accordingly.



Based on application requirements there are particular functions that need to be enabled on the Application Partition in order to utilize the HSMs functionality. The most often used commands are included below. These can be enabled under the "Commands" tab.

PKCS #11 Communication Commands

- ECHO: Communication Test/Retrieve Version
- PRMD: Retrieve HSM restrictions
- RAND: Generate random data
- HASH: Retrieve device serial
- GPKM: Retrieve key table information
- GPKS: General purpose key settings get/change
- GPKR: General purpose key settings get (read-only)

Key Operations Commands

- APFP: Generate PKI Public Key from Private Key
- ASYL: Load asymmetric key into key table
- GECC: Generate an ECC Key Pair
- GPCA: General purpose add certificate to key table
- GPGS: General purpose generate symmetric key
- GPKA: General purpose key add
- GPKD: General purpose key slot delete/clear
- GRSA: Generate RSA Private and Public Key
- LRSA: Load key into RSA Key Table
- RPFP: Get public components from RSA private key

Interoperable Key Wrapping

- GPKU: General purpose key unwrap (unrestricted)
- GPUK: General purpose key unwrap (preserves key usage)
- GPKW: General purpose key wrap (unrestricted)
- GPWK: General purpose key wrap (preserves key usage)

Data Encryption Commands

- ADPK: PKI Decrypt Trusted Public Key
- GHSH: Generate a Hash (Message Digest)
- GPED: General purpose data encrypt and decrypt
- GPGC: General purpose generate cryptogram from key slot
- GPMC: General purpose MAC (Message Authentication Code)
- GPSR: General purpose RSA encrypt/decrypt or sign/verify with recovery
- HMAC: Generate a hash-based message authentication code
- RDPK: Get Clear Public Key from Cryptogram

Signing Commands

- ASYS: Generate a Signature Using a Private Key
- ASYV: Verify a Signature Using a Public Key
- GPSV: General purpose data sign and verify
- RSAS: Generate a Signature Using a Private Key

Alternatively, the following **FXCLI** commands can be used to create the new Application Partition and enable all of the functions that are needed:

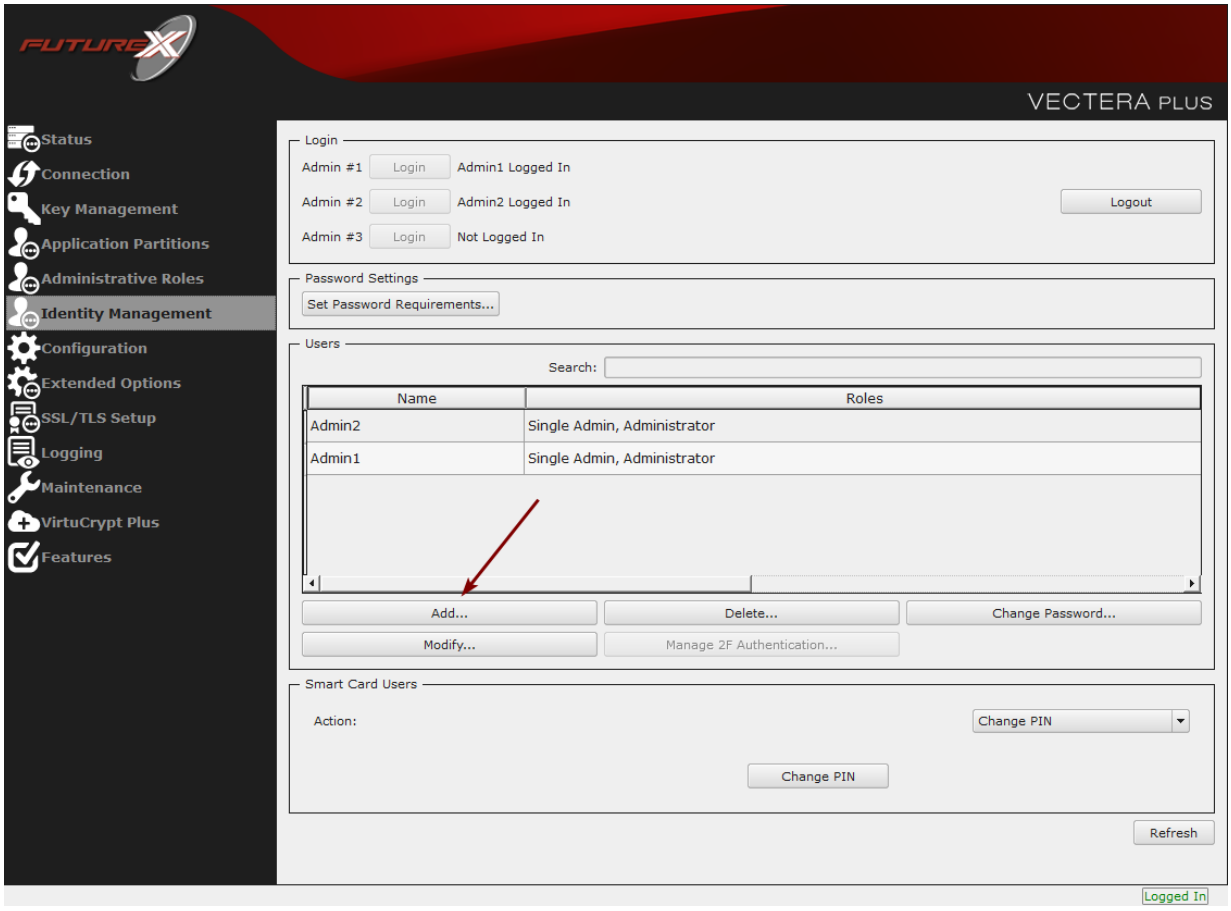
```
$ role add --name Role_Name --application --key-range (0,999) --perm "Keys:Authorized" --perm "Key-
s:Import PKI" --perm "Keys:No Usage Wrap"
```

```
$ role modify --name [role_name] --clear-perms --add-perm Excrypt:ECHO --add-perm Excrypt:PRMD --add-
perm Excrypt:RAND --add-perm Excrypt:HASH --add-perm Excrypt:GPKM --add-perm Excrypt:GPKS --add-perm
Excrypt:GPKR --add-perm Excrypt:APFP --add-perm Excrypt:ASYL --add-perm Excrypt:GECC --add-perm
Excrypt:GPCA --add-perm Excrypt:GPGS --add-perm Excrypt:GPKA --add-perm Excrypt:GPKD --add-perm
Excrypt:GRSA --add-perm Excrypt:LRSA --add-perm Excrypt:RPFP --add-perm Excrypt:GPKU --add-perm
Excrypt:GPUK --add-perm Excrypt:GPKW --add-perm Excrypt:GPWK --add-perm Excrypt:ADPK --add-perm
Excrypt:GHSH --add-perm Excrypt:GPED --add-perm Excrypt:GPGC --add-perm Excrypt:GPMC --add-perm
Excrypt:GPSR --add-perm Excrypt:HMAC --add-perm Excrypt:RDPK --add-perm Excrypt:ASYS --add-perm
Excrypt:ASYV --add-perm Excrypt:GPSV --add-perm Excrypt:RSAS
```

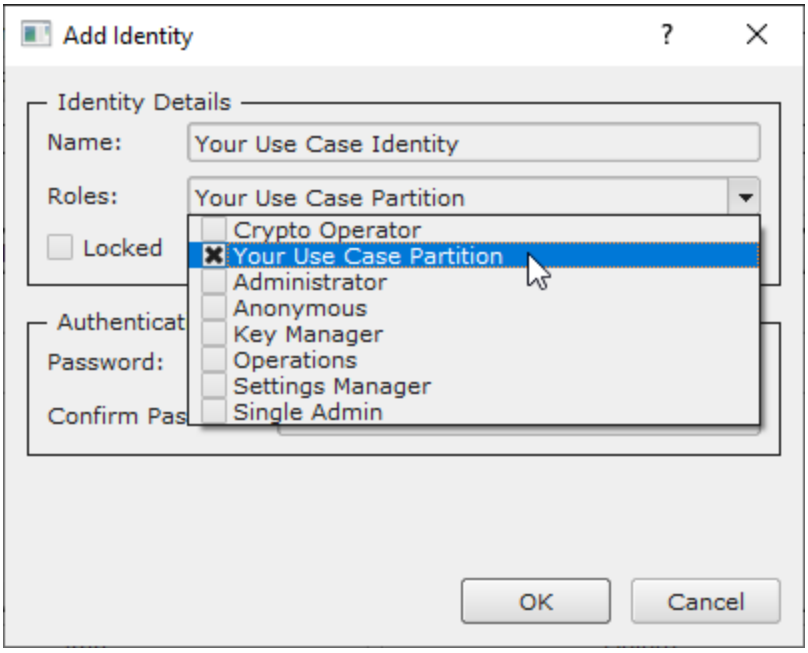
[10.6] CREATE NEW IDENTITY AND ASSOCIATE IT WITH THE NEWLY CREATED APPLICATION PARTITION

*For this step you will need to be logged in with an identity that has a role with permissions **Identity:Add**. The default Administrator role and Admin identities can be used.*

A new identity must be created, which will need to be associated with the Application Partition created in the previous step. To create this new identity, go to *Identity Management*, and click "Add".



Specify a name for the new identity, and in the Roles dropdown select the name of the Application Partition created in the previous step. This will associate the new Identity with the Application Partition that you created.



Alternatively, the following **FXCLI** command can be used to create a new Identity and associate it with the role that was created:

```
$ identity add --name Identity_Name --role Role_Name --password safest
```

This new identity must be set in fxpkcs11.cfg file, in the following section:

```
#HSM crypto operator identity name
<CRYPTO-OPR>     [insert name of identity that you created]     </CRYPTO-OPR>

# Production connection
<PROD-ENABLED>    YES        </PROD-ENABLED>
<PROD-PORT>        9100         </PROD-PORT>
```

NOTE: Crypto Operator in the fxpkcs11.cfg file must match exactly the name of the identity created in the HSM.

[10.7] CONFIGURE TLS AUTHENTICATION

For this step you will need to be logged in with an identity that has a role with permissions ***Keys:All Slots, Management Commands:Certificates, Management Commands:Keys, Security:TLS Sign****, and* ***TLS Settings:Upload Key****. The default Administrator role and Admin identities can be used.*

Enable Server-Side Authentication (Option 1)

Mutually authenticating to the HSM using client certificates is recommended, but server-side authentication is also supported. To enable server-side authentication go to *SSL/TLS Setup*, then select the Excrypt Port and enable the "Allow Anonymous" setting.

Alternatively, the following **FXCLI** command can be used to enable server-side authentication with the "Allow Anonymous" SSL/TLS setting:

```
$ tls-ports set -p "Excrypt Port" --anon
```

Create Connection Certificates for Mutual Authentication (Option 2)

Mutually authenticating to the HSM using client certificates is recommended, and enforced by default. In the example below, FXCLI is utilized to generate a CA that then signs the HSM server certificate and a client certificate. The client keys and CSR are generated in Windows PowerShell with OpenSSL. For other options for managing certificates required for mutual authentication with the HSM, please review the relevant Administrator's guide.

Find the **FXCLI** program that was installed with FXTools, and run it as an administrator.

Things to note:

- For this example, the computer running FXCLI is connected to the front port of the HSM. Remote management is possible however, using the HSMs Web Portal, or the Excrypt Touch.
- For commands that create an output file, if you do not specify a file path (as is the case here) it will save the file to the directory from which the FXCLI program is executed.
- Using user-generated certificates requires a PMK to be loaded on the HSM.
- If you run **help** by itself it will show a full list of available commands. You can see all of the available options for any given command by running the command name followed by **help**.

```
# Connect your laptop to the HSM via the USB port on the front, then run this command.
$ connect usb
```

```
# Log in with both default Admin identities. This command will prompt for the username and password.
You will need to run this command twice.
$ login user
```

```
# Generate TLS CA and store it in an available key slot on the HSM
$ generate --algo RSA --bits 2048 --usage mak --name TlsCaKeyPair --slot next
```

```
# Create root certificate
$ x509 sign \
    --private-slot TlsCaKeyPair \
    --key-usage DigitalSignature --key-usage KeyCertSign \
```

```
    --ca true --pathlen 0 \
    --dn 'O=Futurex\CN=Root' \
    --out TlsCa.pem
```

```
# Generate the server keys for the HSM
$ tls-ports request --pair "Excrypt Port" --file production.csr --pki-algo RSA
```

```
# Sign the server CSR with the newly created TLS CA
$ x509 sign \
    --private-slot TlsCaKeyPair \
    --issuer TlsCa.pem \
    --csr production.csr \
    --eku Server --key-usage DigitalSignature --key-usage KeyAgreement \
    --ca false \
    --dn 'O=Futurex\CN=Production' \
    --out TlsProduction.pem
```

```
# Push the signed server PKI to the production port on the HSM
$ tls-ports set --pair "Excrypt Port" \
    --enable \
    --pki-source Generated \
    --clear-pki \
    --ca TlsCa.pem \
    --cert TlsProduction.pem \
    --no-anon
```

***NOTE**: The following OpenSSL commands will need to be run from Windows PowerShell, rather than from the FXCLI program.*

```
# Generate the client keys
$ openssl genrsa -out privatekey.pem 2048
```

```
# Generate client CSR
$ openssl req -new -key privatekey.pem -out ClientPki.csr -days 365
```

Using FXCLI, sign the CSR that was just generated using OpenSSL.

```
# Sign the client CSR under the root certificate that was created
$ x509 sign  \
 --private-slot TlsCaKeyPair \
 --issuer TlsCa.pem \
 --csr ClientPki.csr \
 --eku Client --key-usage DigitalSignature --key-usage KeyAgreement \
 --dn 'O=Futurex\CN=Client' \
 --out SignedPki.pem
```

Switch back to Windows PowerShell for the remaining commands.

```
## Make PKCS12 file
# Concatenate the signed client cert and private key into one pem file
$ cat SignedPki.pem >> Tree.pem
```

```
$ cat privatekey.pem >> Tree.pem
```

```
# Use OpenSSL to create a PKCS#12 file that can be used to authenticate, as a client, using our PKCS
#11 library
$ openssl pkcs12 -export -in Tree.pem -out PKI.p12 -name "ClientPki" -password pass:safest
```

[11] EDIT THE FXPKCS11 CONFIGURATION FILE

The *fxpkcs11.cfg* file allows the user to set the PKCS #11 library to connect to the HSM. To edit, run a text editor as an Administrator and edit the configuration file accordingly. Most notably, the fields shown below must be set inside the **<HSM>** section (note that the full *fxpkcs11.cfg* file is not included).

NOTE: Our PKCS #11 library expects the PKCS #11 config file to be in a certain location (*C:\Program Files\Futurex\fxpkcs11\fxpkcs11.cfg* for Windows and */etc/fxpkcs11.cfg* for Linux), but that location can be overwritten using an environment variable (FXPKCS11_CFG).

```
# Connection information
<ADDRESS>             10.0.5.58           </ADDRESS>

# Load balancing
<FX-LOAD-BALANCE>           YES               </FX-LOAD-BALANCE>

# Log configuration
<LOG-FILE> C:\Program Files\Futurex\fxpkcs11\fxpkcs11.log </LOG-FILE>

# HSM crypto operator identity name
<CRYPTO-OPR>          [identity_name]     </CRYPTO-OPR>

# Production connection
<PROD-ENABLED>        YES                 </PROD-ENABLED>
<PROD-PORT>           9100                </PROD-PORT>

# Production SSL information
<PROD-TLS-ANONYMOUS>    NO                </PROD-TLS-ANONYMOUS>
<PROD-TLS-CA>     C:\Program Files\Futurex\fxpkcs11\TlsCa.pem    </PROD-TLS-CA>
<PROD-TLS-CA>     C:\Program Files\Futurex\fxpkcs11\TlsProduction.pem    </PROD-TLS-CA>
<PROD-TLS-KEY>     C:\Program Files\Futurex\fxpkcs11\PKI.p12     </PROD-TLS-KEY>
<PROD-TLS-KEY-PASS>      safest           </PROD-TLS-KEY-PASS>
```

In the **<ADDRESS>** field, the IP of the HSM that the PKCS #11 library will connect to is specified.

If a Guardian is being used to manage HSMs in a cluster, the **<FX-LOAD-BALANCE>** field must be defined as "YES". If a Guardian is not being used it should be set to "NO".

In the **<LOG-FILE>** field, set the path to the PKCS #11 log file.

In the **<CRYPTO-OPR>** field, the name of the identity created in step 7.6 needs to be specified.

The **<PROD-ENABLED>** and **<PROD-PORT>** fields declare that the PKCS #11 library will connect to Production port 9100.

The **<PROD-TLS-ANONYMOUS>** field defines whether the PKCS #11 library will be authenticating to the server or not.

The **<PROD-TLS-KEY>** field defines the location of the client private key. Supported formats for the TLS private key are PKCS #1 clear private keys, PKCS #8 encrypted private keys, or a PKCS #12 file that contains the private key and certificates encrypted under the password specified in the **<PROD-TLS-KEY-PASS>** field.

Because a PKCS #12 file is defined in the **<PROD-TLS-KEY>** field in this example, it is not necessary to define the signed client cert with the **<PROD-TLS-CERT>** tag, or the CA cert/s with one or more instances of the **<PROD-TLS-CA>** tag.

For additional details reference the Futurex PKCS #11 technical reference found on the Futurex Portal.

Once the *fxpkcs11.cfg* is edited, run the *PKCS11Manager* file to test the connection against the HSM, and check the *fxpkcs11.log* for errors and information. For more information, see our Administrator's Guide.

[12] JAVA KEYSTORE CREATION

A server's secure connections rely on a private server key and certificate to be stored in the Java KeyStore and saved on the HSM. This server certificate will be presented to clients when connecting to the server. The KeyStore is typically created using the Keytool application bundled with Java (Typically located in *$JAVA_HOME/jre/bin/*). The following steps outline the KeyStore creation process, once again using Apache Tomcat as an example application:

- Generate a server keypair (which also includes a self-signed certificate that will be stored in the HSM.)
- Generate and export a CSR (Certificate Signing Request) to be signed by an External CA (if needed.)
- Import the external CA root certificate and server certificate signed by the External CA.

NOTE: For testing purposes, meaning to verify that the self-signed certificate is being created in the HSM and that the server is presenting it to client connections, it is enough to execute only section 9.1, *Generate a Server Keypair and Self-signed Certificate*, and then move on to server configuration.

NOTE: If a connection using an external CA is required, only then is it necessary to go to section 9.2, *Generate and Export CSR*, then sign the CSR using an external CA authority (which could be created with OpenSSL) and finally proceed with section 9.3, *Import CA Root Certificate*, and section 9.4, *Import Server Certificate Signed by CA*. For a full example of external CA creation please refer to APPENDIX B.

[12.1] GENERATE A SERVER KEYPAIR AND SELF-SIGNED CERTIFICATE

```
keytool -genkeypair -keyalg RSA -keysize 2048 -alias tomcatdemo1 -keystore NONE -storetype PKCS11 -
providername "Futurex" -providerclass "fx.security.pkcs11.SunPKCS11"
```

NOTE: *-alias* is a field used to set a name to identify the key pair and certificate to be generated. It can be any name (example: *tomcatdemo1*), but the same name must then be used in server configuration.

Upon the execution of the previous instruction, the Keytool application will ask for information for the server certificate to be generated.

Enter the KeyStore password: (This password must be saved. It may be required later for web server configuration and certificate importing.)

1. What is your first and last name?

[Unknown]: www.example.com

2. What is the name of your organizational unit?

[Unknown]: Engineering

3. What is the name of your organization?

[Unknown]: Futurex

4. What is the name of your City or Locality?

[Unknown]: Bulverde

5. What is the name of your State or Province?

[Unknown]: TX

6. What is the two-letter country code for this unit?

[Unknown]: US

7. Is CN=www.example.com, OU=Engineering, O=Futurex, L=Bulverde, ST=TX, C=US correct?

[no]: yes

NOTE: Command [9.1] generated a self-signed certificate. If a CA-Signed certificate is required, continue with steps [9.2], [9.3], and [9.4] (see APPENDIX B for additional details.) If a CA-signed certificate is not required, proceed to server configuration.

[12.2] GENERATE AND EXPORT A CSR

```
keytool -certreq -alias tomcatdemo1 -file example.csr -keystore NONE -storetype PKCS11 -providername
"Futurex" -providerclass "fx.security.pkcs11.SunPKCS11"
```

Enter KeyStore password:

The CSR must be signed by a CA, either third-party or internal. Once signed, the server certificate returned by the CA will be imported along with the CA certificate.

[12.3] IMPORT A CA ROOT CERTIFICATE

```
keytool -import -trustcacerts -alias tomcatdemo_ca -keystore NONE -file ca.crt -storetype PKCS11 -pro-
vidername "Futurex" -providerclass "fx.security.pkcs11.SunPKCS11"
```

Enter KeyStore password:

1. Trust this certificate?

[no]: yes

2. Certificate was added to KeyStore

[12.4] IMPORT A SERVER CERTIFICATE (SERVER CERTIFICATE SIGNED BY CA)

```
keytool -importcert -alias tomcatdemo1 -keystore NONE -file server.crt -storetype PKCS11 -providername
"Futurex" -providerclass "fx.security.pkcs11.SunPKCS11"
```

Enter the KeyStore password:

Certificate reply was installed in KeyStore.

APPENDIX A: USING THE GUARDIAN SERIES 3 TO CONFIGURE THE HSM

[12.5] SETTING UP THE GUARDIAN SERIES 3 TO MANAGE CLIENT FUTUREX HSM'S

If a user has multiple HSMs, the Guardian Series 3 can be used to create and manage device groups, provide load balancing, configuration management capabilities, peering, redundancy, and notifications for client Futurex devices.

Preconditions for Futurex Device Group Configuration Through the Guardian Series 3

In order to connect client Futurex HSMs for management by the Guardian Series 3, a number of preconditions for all of the involved HSMs must be met.

NOTE: Futurex certificates will be used for the connection between the Guardian Series 3 and the HSMs in the following sections. Futurex certificates are preloaded on every unit. There is a private key and associated signed-certificate, which is signed under a Customer "X" Futurex TLS CA tree. In conjunction with a client certificate signed under the same CA, these certificates can be used for secure communications with a Futurex unit without the need for generating and managing certificates on a customer-managed CA. If you wish to utilize a user CA, please refer to the relevant Administrator's guide.

Preconditions for Client Futurex HSMs

1. The HSM must be network-attached, with an IP address configured and an Ethernet cable plugged into a local area network.
2. If using user certificates, the HSM must have a major key loaded. If Futurex certificates are utilized this precondition does not apply.
3. If using TLS between the HSM and the Guardian Series 3, the HSM must have the proper TLS settings enabled. If a mutually authenticated connection is to be established, these settings must match on the Guardian Series 3. Otherwise, selecting this connection type will result in a failure to add the device to the group.
4. The HSM must be signed using the same root certificate as the Guardian Series 3. This is automatic if using Futurex certificates.
5. The HSM must have the same date and time settings as the Guardian Series 3, as well as other units in the device group. The date and time settings are synced automatically when you sign in to the Device Group on the Guardian Series 3, so no user configuration is required for this.
6. All HSMs in the device group must be of the same model, and they must have the same firmware version and feature set.

Preconditions for Guardian Series 3

In order to add a client Futurex HSM to a device group, the following preconditions must first be met.

1. The Guardian Series 3 must be network-attached, with an IP address configured and an Ethernet cable plugged into a local area network.

2. If using user certificates, the Guardian Series 3 must have a major key loaded. If Futurex certificates are utilized this precondition does not apply.
3. If using TLS between the Guardian Series 3 and HSM, the Guardian Series 3 must have the proper TLS settings enabled. If a mutually authenticated connection is to be established, these settings must match on all client HSMs. Otherwise, selecting the connection type will result in a failure to add the device to the group.
4. The Guardian Series 3 must be signed using the same root certificate as the client Futurex device. This is automatic if using Futurex certificates.
5. The Guardian Series 3 should have the same date and time settings as all units in the device group. The date and time settings are synced automatically when you sign in to the Device Group on the Guardian Series 3, so no user configuration is required for this.
6. The Guardian-required Host API commands must be enabled.

Creating a Client Futurex Device Group

Device groups help simplify the management of information on multiple client Futurex devices by controlling them through a single interface. The devices need to be associated with groups in order to harness the Guardian Series 3 for replication, synchronization, load balancing, monitoring, failover, and alerting features. Use the following procedures to create a device group and add devices.

1. Select Encryption Devices from the left toolbar. Click the Add Group button at the bottom of the window to open the Encryption Device Group window.

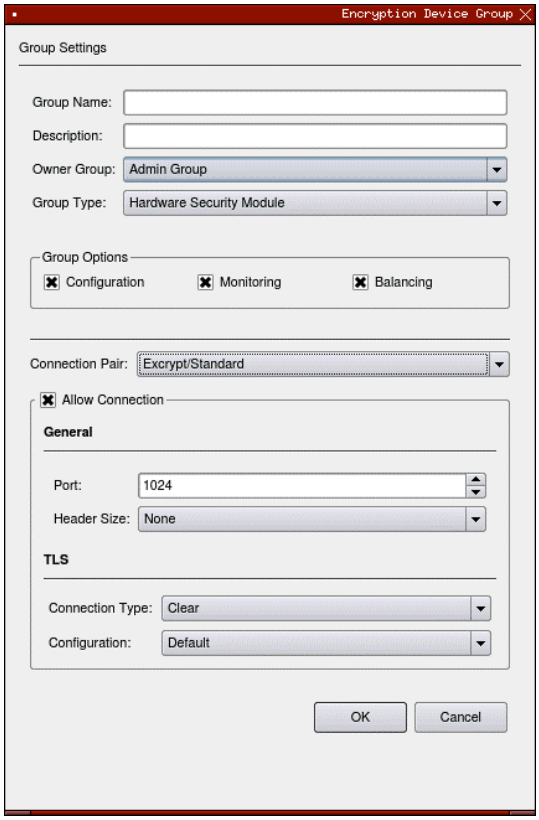


FIGURE: ENCRYPTION DEVICE GROUP WINDOW

2. Enter a Group Name in the associated field.
3. Enter a Description of the group in the associated field.
4. Select the desired Owner Group from the drop-down menu.
5. Select the Group Type.
    - For this use case you will select **Hardware Security Module**: Excrypt SSP9000, Excrypt SSP9000 Enterprise, Excrypt Plus, Excrypt SSP Enterprise v.2, or Vectera Plus devices.

    NOTE: As mentioned previously, devices in the Hardware Security Module group may only be added to groups of like devices.

6. Define Group Options.
    - **Configuration**: Allows you to remotely configure all Futurex HSMs in group.
    - **Monitoring**: Allows you to monitor all Futurex HSMs in group.
    - **Balancing**: API calls sent to this group will be load-balanced between all devices in the group.
7. Choose the Connection Pair using the drop-down menu. The connection pairs available will vary depending on the type of device group. For PKCS #11, only the Excrypt/Standard connection pair is needed. The HTTP and International connection pairs should be disabled.
    - **Excrypt/Standard**: used to connect with the Excrypt or Standard APIs for transaction processing using Futurex HSMs
    - **HTTP**: used to connect with the client Futurex device's web management portal, or the Registration Authority in the case of KMES Series units with Registration Authority functionality enabled, or to the device's RESTful web API
    - **International**: the connection pair used to connect with the International API for transaction processing using Futurex HSMs, when the Excrypt Universal Interface license is enabled
8. Check Allow Connection and choose the Port and Header Size, if applicable.
9. Select the Connection Type for each connection pair from the drop-down menu. The options are Clear, SSL, or Anonymous TLS, but **SSL** should be used and is the default.
10. Click OK to create the group.

Adding Devices to a Device Group

How to Add a Device to a Device Group

Groups are defined by device type. When selecting a device to add, chose the group of the same model, as it is not possible to mix and match different devices within the same group.

1. Select the group to add the client device to.
2. Click the Add Device button at the bottom of the screen. The Encryption Device window will appear.

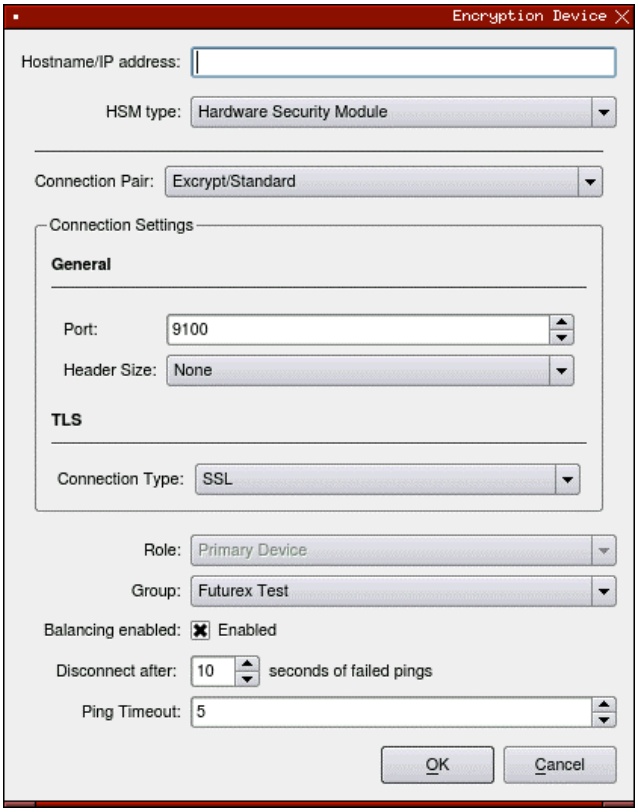


FIGURE: ENCRYPTION DEVICE WINDOW

3. Enter the Hostname of IP address of the client device.

   NOTE: HSMs managed by the Guardian Series 3 in a single group must be using the same firmware version and feature set.

   NOTE: All of the remaining settings in this menu (steps 4-13) should be kept as default if using Futurex certificates.

4. Select the Connection Pair using the drop-down menu. This allows you to set the proper TLS pair for the device in question.
5. Define the Port that the client devices are configured to operate on. There is no need to specify a Header Size.
6. Designate the desired Connection Type and Configuration using the drop-down menus.
7. Select the Role of the device from the associated drop-down menu. This specifies the device's use in the assigned group. Only the Primary Device role will be available for the first device added to the group.

   NOTE: The differences between the 3 main device role types are described below:

   - Primary Device – Designates a device as a primary device in the device group. The configuration details on this device will automatically be replicated to any additional devices added to the device group. The primary device also functions in the same role as a production device.
   - Production Device – Designating a device as a production device will cause it to begin actively processing transactions as soon as it has been synchronized with the group. Multiple production devices may be added to an individual device group.

- **Backup Device** – Designating a device as a backup device will cause it to remain synchronized with the group, but not process transactions, until a production device is removed from service, at which point it will automatically begin processing transactions. The use of backup devices is optional, and multiple backup devices may be added to an individual device group.

8. Select the desired Group from the drop-down menu.
9. To enable balancing, check the box next to Balancing Enabled. This allows the Guardian to evenly distribute requests to devices in the group.
10. Set the number of seconds of failed pings before the Guardian considers the device to be disconnected.
11. Set the desired number of seconds for the ping timeout. The ping timeout is the amount of time before an individual ping is open.
12. Click OK to save changes.

The Details window will open, displaying the connection status for the device, as well as the connection details. Users will be given the option to export this information once the process is complete.

This window can also be reopened by right-clicking on the encryption device and selecting Show Connection Status.

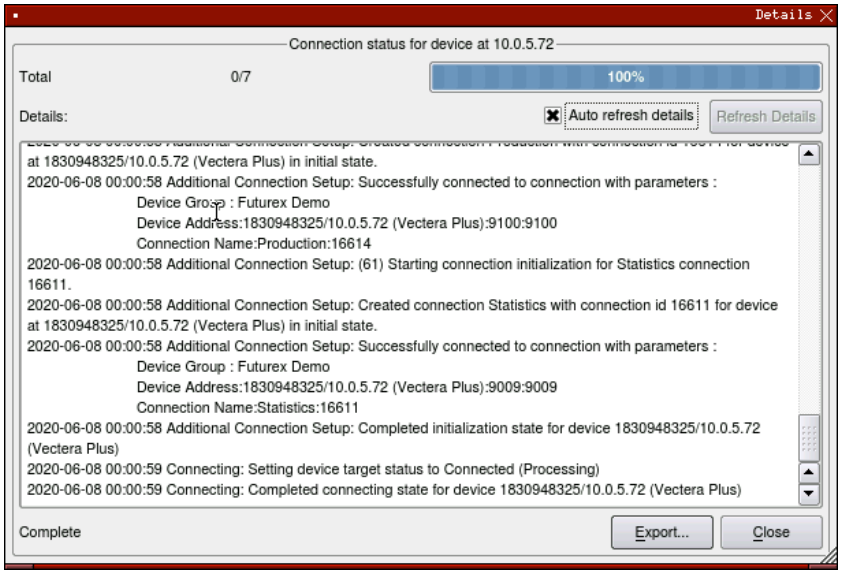


FIGURE: CONNECTION STATUS DETAILS

Troubleshooting Failed Connections

If the connection is failing these are some of the things that you should check:

- Is the Device Group and Device enabled?
- Are the Admin and Excrypt TLS ports configured on the HSM?
- Are the Guardian Series 3 and the HSM using the same CA tree? If using Futurex certificates, they both need to be utilizing either RSA or ECC CA.

NOTE: If port 9100 is failing to connect, there is a problem with the Excrypt port configuration. If port 9009 is failing to connect, there is a problem with the Admin port configuration.

[12.6] CONFIGURING THE HSM THROUGH THE GUARDIAN

Load Futurex Key

For this step you will need to be logged in with an identity that has a role with permissions ***Major Keys:Load****. The default Administrator role and Admin identities can be used.*

The FTK is used to wrap all keys stored on the HSM used with PKCS #11. If using multiple HSMs in a cluster, the same FTK can be used for syncing HSMs. Before an HSM can be used with PKCS #11, it must have an FTK.

Note that this process can also be completed using the Excrypt Manager, FXCLI, the Excrypt Touch or the Guardian Series 3. The instructions that follow will be for the Guardian Series 3. For more information about how to load the FTK into an HSM using the other tools/devices, please see the relevant Administrative Guide.

After logging in, go to the *Encryption Devices* page. Then, right-click on the device group and select "Remote Manage…".

FIGURE: REMOTE MANAGE OPTION

This will pull up the login screen, from which you can log in to the selected device. Once logged in, select **Keys** in the left-hand menu. This will bring you to the **Major Keys** tab. Once there, click on "Load" next to the FTK.

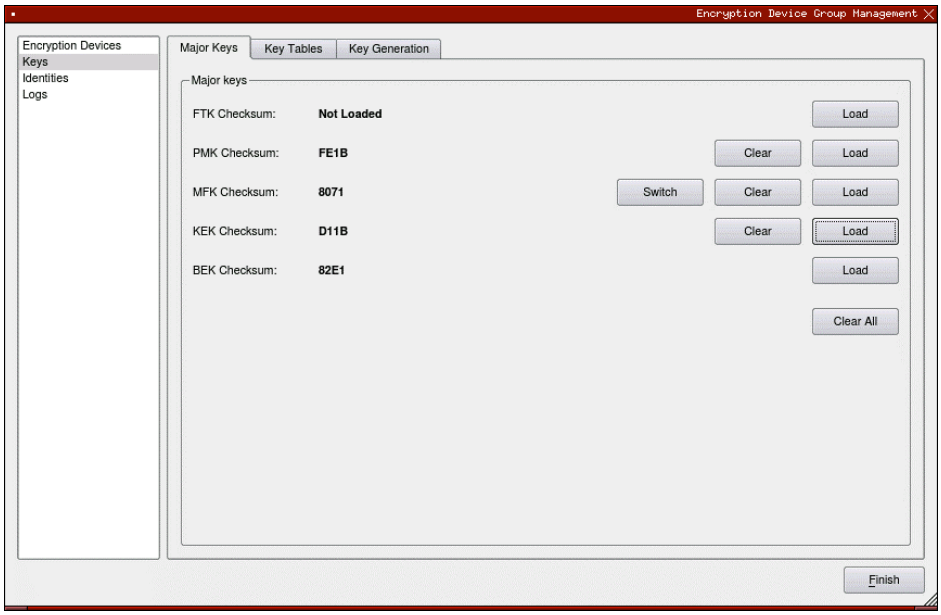


FIGURE: MAJOR KEYS TAB

The first menu in the wizard will have you select the Algorithm, Key length, and Key parts that you want to use for the key that you're loading. Then you will load each of the key parts. For each of the key parts, you will receive confirmation that it was loaded successfully.

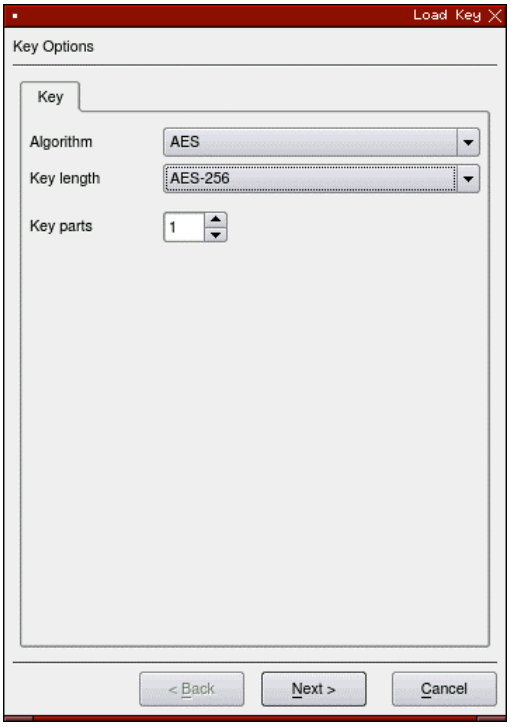


FIGURE: KEY OPTIONS IN LOAD KEY WINDOW

After all key parts have been loaded, you will receive a Final Key Checksum.

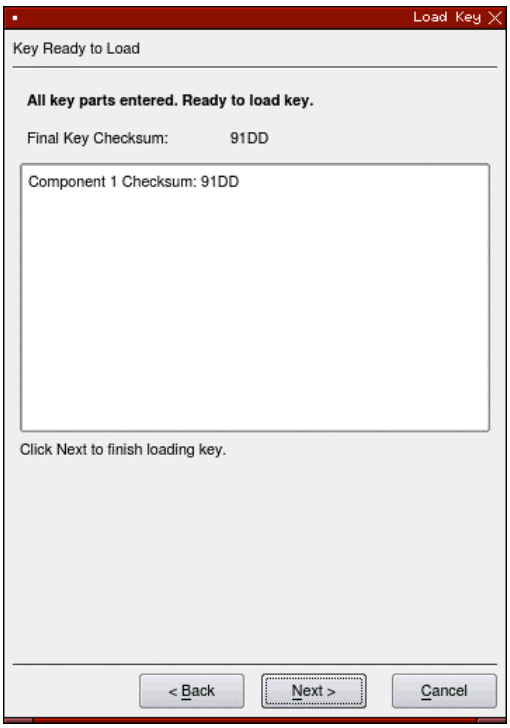


FIGURE: FINAL KEY CHECKSUM IN LOAD KEY WINDOW

After clicking “Next” on the previous screen, the dialogue below will confirm that the key was created successfully.

Configure a Transaction Processing Connection

For this step you will need to be logged in with an identity that has a role with permissions ***Role:Add****,* ***Role:Assign All Permissions****,* ***Role:Modify****,* ***Keys:All Slots****, and* ***Command Settings:Excrypt****. The default Administrator role and Admin identities can be used.*

NOTE: For the purposes of this integration guide you can consider the terms "Application Partition" and "Role" to be synonymous. For more information regarding Application Partitions, Roles, and Identities, please refer to the relevant Administrator's guide.

Configure a Transaction Processing Connection

Before an application logs in to the HSM with an authenticated user, it first connects as an unauthenticated user under the “Anonymous” Application Partition. For this reason, it is necessary to take steps to harden the “Anonymous” Application Partition. These three things need to be configured for the “Anonymous” partition:

1. It should not have access to the “All Slots” permissions.
2. It should not have access to any key slots.
3. Only the PKCS #11 communication commands should be enabled.

While still logged in to the Device Group, navigate to the Identities menu, and then the Application Partition Management tab.

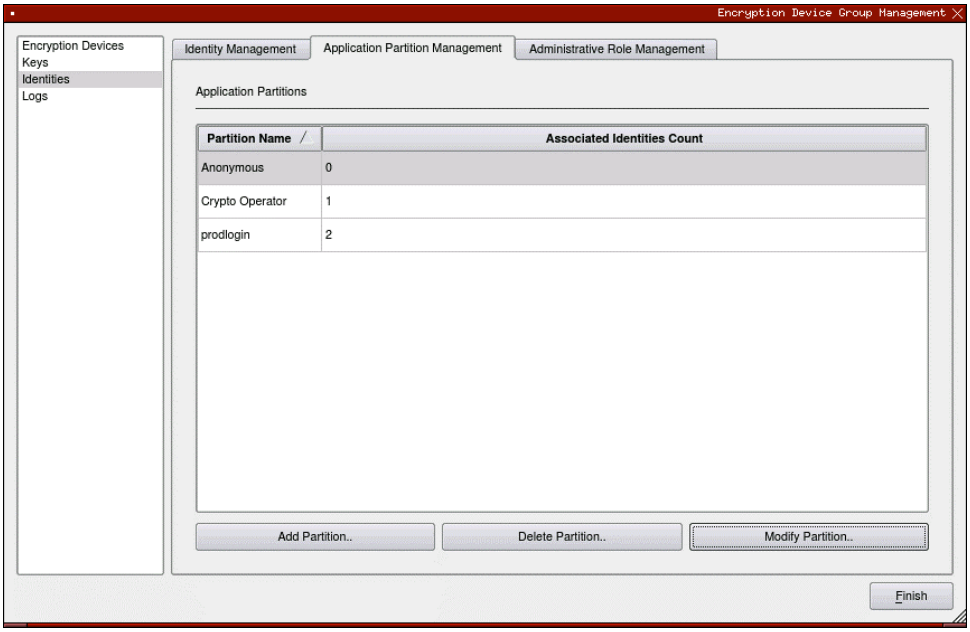


FIGURE: APPLICATION PARTITION MANAGEMENT TAB

Select the “Anonymous” Application Partition, and click *Modify Partition*, which will pull up this menu.

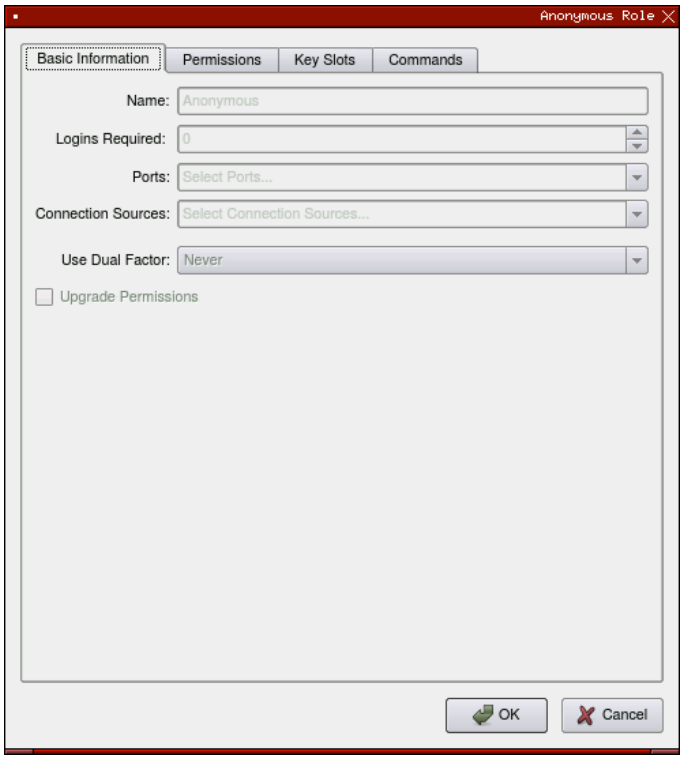


FIGURE: BASIC INFORMATION IN THE ANONYMOUS ROLE WINDOW

Navigate to the “Permissions” tab and ensure that the “All Slots” key permission is unchecked. None of the other key permissions should be enabled either.

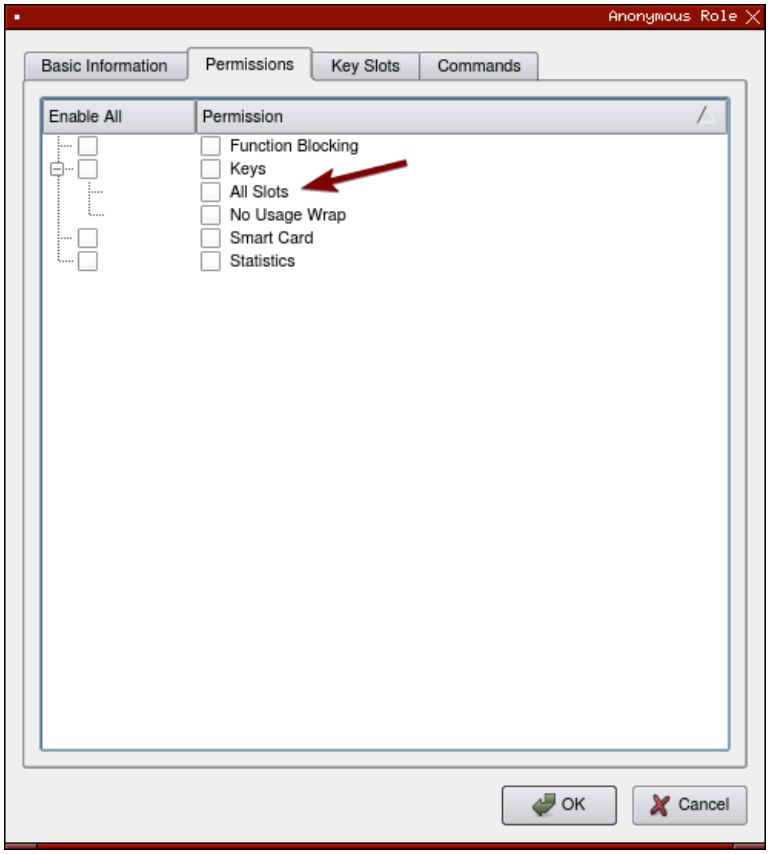


FIGURE: "ALL SLOTS" KEY PERMISSION

Under the "Key Slots" tab you need to ensure that there are no key ranges specified. By default, the Anonymous Application Partition has access to the entire range of key slots on the HSM.

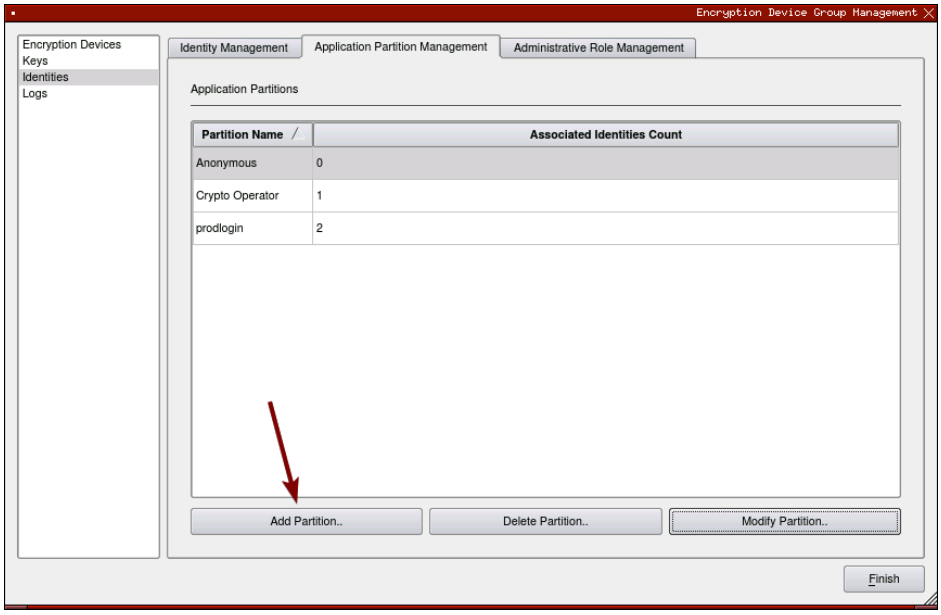
Lastly, under the "Commands" tab make sure that only the following PKCS #11 Communication commands are enabled for the Application Partition that you created:

- ECHO: Communication Test/Retrieve Version
- PRMD: Retrieve HSM restrictions
- RAND: Generate random data
- HASH: Retrieve device serial
- GPKM: Retrieve key table information
- GPKS: General purpose key settings get/change
- GPKR: General purpose key settings get (read-only)

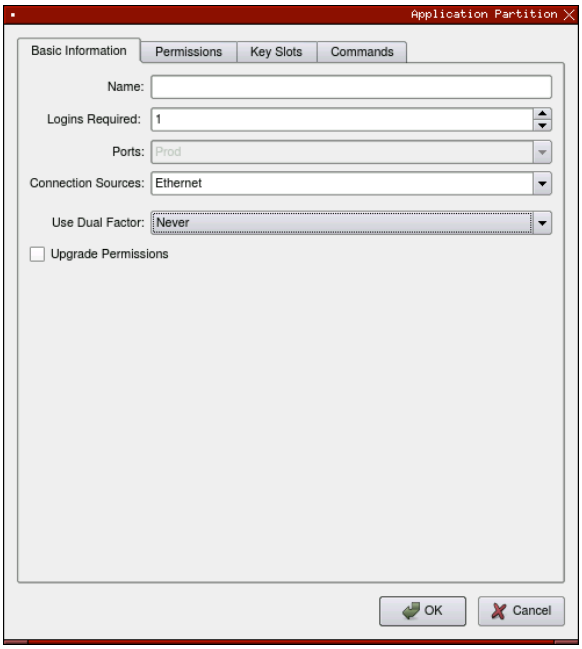
Create an Application Partition

In order for application segregation to occur on the HSM, an Application Partition must be created specifically for your use-case. Application partitions are used to segment the permissions and keys on an HSM between applications. The process for configuring a new application partition is outlined in the following steps:

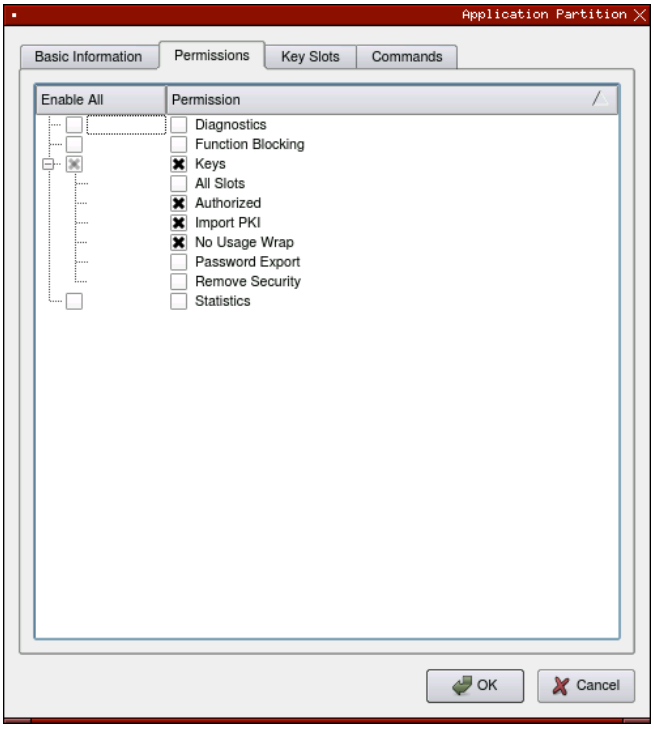
From the Application Partitions tab and click the Add Partition button at the bottom of the menu.



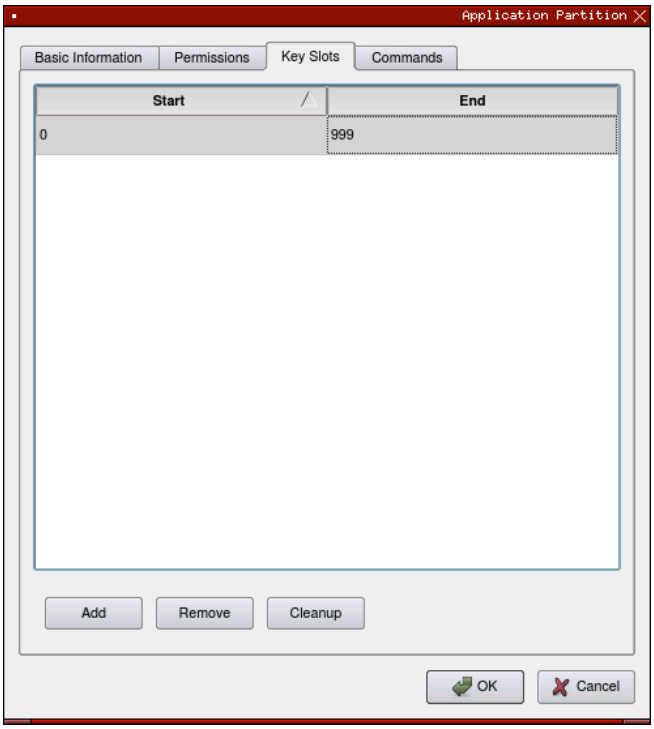
Fill in all of the fields in the “Basic Information” tab, as shown below. The information that is essential is Logins Required being set to “1”, the Ports being set to “Prod”, and the Connection Sources being set to “Ethernet”.



Under the "Permissions" tab, select the Key permissions shown in the screenshot below. The Authorized permission allows for keys that require login. The Import PKI permission allows trusting an external PKI, which is used by some applications to allow for PKI symmetric key wrapping (It is not recommended to enable unless using this use case). The No Usage Wrap permission allows for interoperable key wrapping without defining key usage as part of the wrapped key (This is only recommended if exchanging keys with external entities or using the HSM to wrap externally used keys).



Under Key Slots, it is recommended that you create a range of 1000 total keys (here we've specified the key range 0-999), which do not overlap with another Application Partition. Within this range, there must be ranges for both symmetric and asymmetric keys. If more keys are required by the application, configure accordingly.



Based on application requirements there are particular functions that need to be enabled on the Application Partition in order to utilize the HSMs functionality. The most often used commands are included below. These can be enabled under the "Commands" tab.

PKCS #11 Communication Commands

- **ECHO**: Communication Test/Retrieve Version
- **PRMD**: Retrieve HSM restrictions
- **RAND**: Generate random data
- **HASH**: Retrieve device serial
- **GPKM**: Retrieve key table information
- **GPKS**: General purpose key settings get/change
- **GPKR**: General purpose key settings get (read-only)

Key Operations Commands

- **APFP**: Generate PKI Public Key from Private Key
- **ASYL**: Load asymmetric key into key table
- **GECC**: Generate an ECC Key Pair
- **GPCA**: General purpose add certificate to key table
- **GPGS**: General purpose generate symmetric key
- **GPKA**: General purpose key add
- **GPKD**: General purpose key slot delete/clear
- **GRSA**: Generate RSA Private and Public Key
- **LRSA**: Load key into RSA Key Table
- **RPFP**: Get public components from RSA private key

Interoperable Key Wrapping

- **GPKU**: General purpose key unwrap (unrestricted)
- **GPUK**: General purpose key unwrap (preserves key usage)
- **GPKW**: General purpose key wrap (unrestricted)
- **GPWK**: General purpose key wrap (preserves key usage)

Data Encryption Commands

- **ADPK**: PKI Decrypt Trusted Public Key
- **GHSH**: Generate a Hash (Message Digest)
- **GPED**: General purpose data encrypt and decrypt
- **GPGC**: General purpose generate cryptogram from key slot
- **GPMC**: General purpose MAC (Message Authentication Code)
- **GPSR**: General purpose RSA encrypt/decrypt or sign/verify with recovery
- **HMAC**: Generate a hash-based message authentication code
- **RDPK**: Get Clear Public Key from Cryptogram

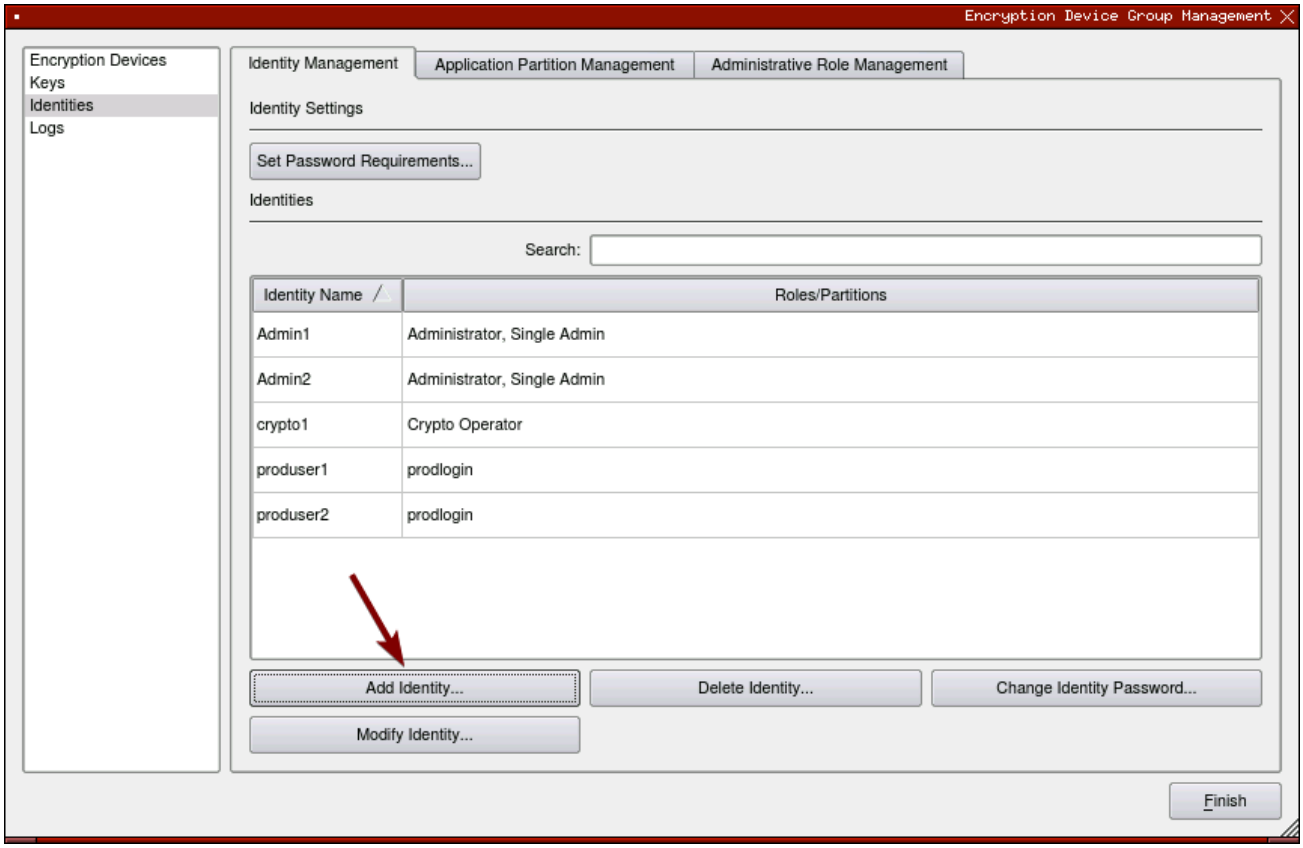
Signing Commands

- **ASYS**: Generate a Signature Using a Private Key
- **ASYV**: Verify a Signature Using a Public Key
- **GPSV**: General purpose data sign and verify
- **RSAS**: Generate a Signature Using a Private Key

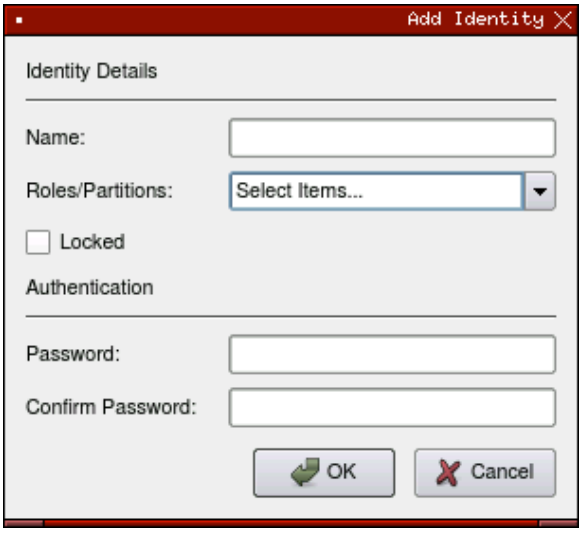
Create new Identity and associate it with the newly created Application Partition

For this step you will need to be logged in with an identity that has a role with permissions ***Identity:Add****. The default Administrator role and Admin identities can be used.*

A new identity must be created, which will need to be associated with the Application Partition created in step 7.5. To create this new identity, go to the *Identity Management* tab, and click "Add Identity...".



Specify a name for the new Identity, and in the Roles dropdown select the name of the Application Partition created in the previous step. This will associate this new Identity with that Application Partition.

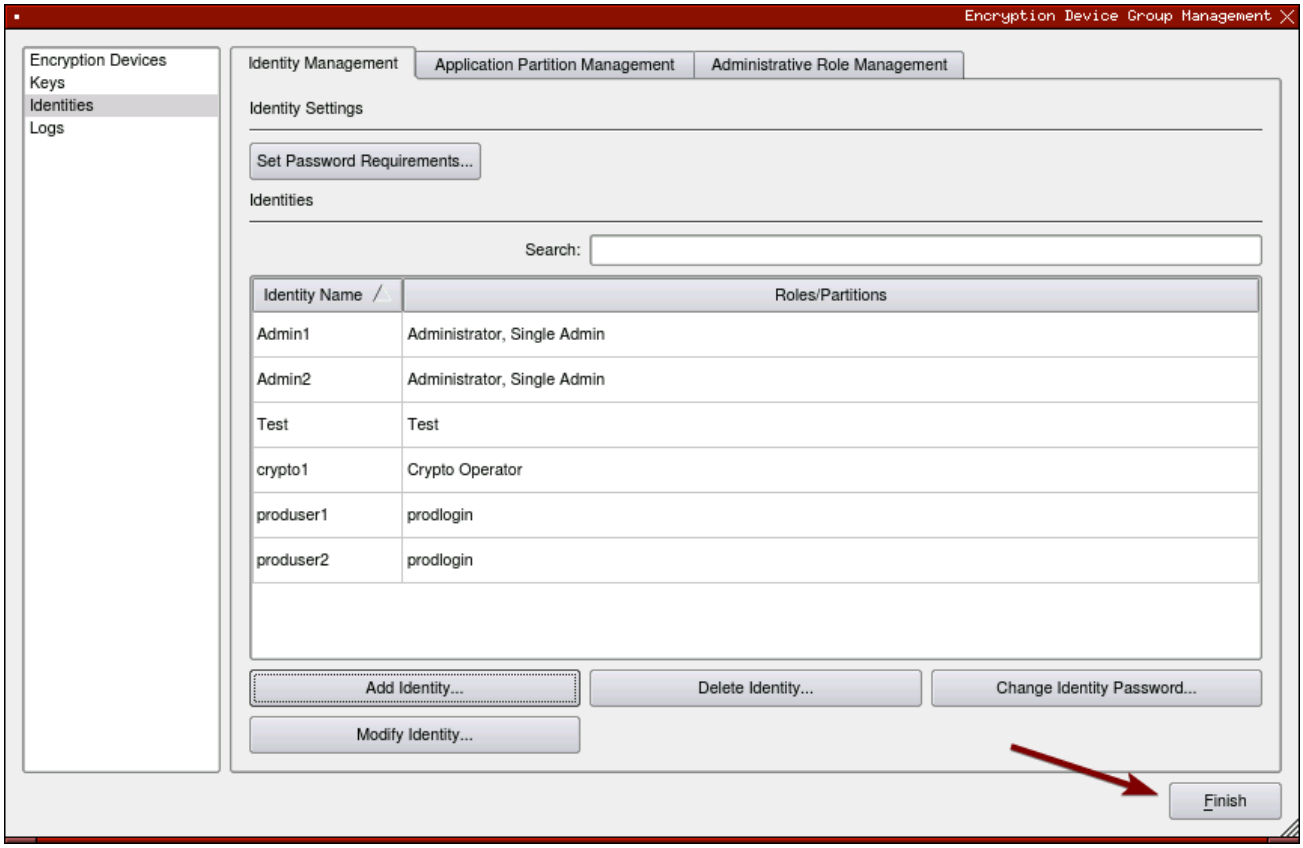


This new identity must be set in the fxpkcs11.cfg file, in the following section:

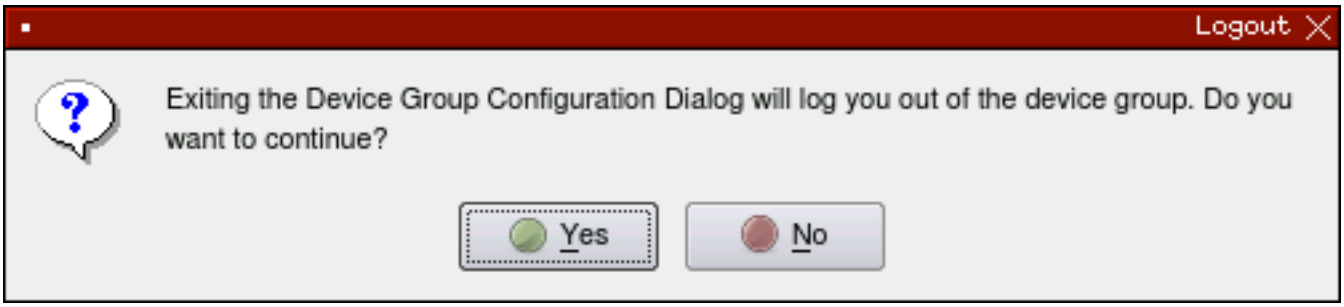
```
# HSM crypto operator identity name
<CRYPTO-OPR> [insert name of Identity that you created] </CRYPTO-OPR>

# Production connection
<PROD-ENABLED> YES </PROD-ENABLED>
<PROD-PORT> 9100 </PROD-PORT>
```

NOTE: Crypto Operator in the fxpkcs11.cfg file must match exactly the name of the identity created in the HSM.

Click the "Finish" button to exit out of this menu and log out of the device group.



Click "Yes" at the following prompt.



Configure TLS Authentication

For this step you will need to be logged in with an identity that has a role with permissions ***Keys:All Slots****,* ***Management Commands:Certificates****,* ***Management Commands:Keys****,* ***Security:TLS Sign****, and* ***TLS Settings:Upload Key****. The default Administrator role and Admin identities can be used.*

Enable Server-Side Authentication (Option 1)

Mutually authenticating to the HSM using client certificates is recommended, but server-side authentication is also supported. To enable server-side authentication go to *SSL/TLS Setup*, then select the Excrypt Port and enable the "Allow Anonymous" setting.

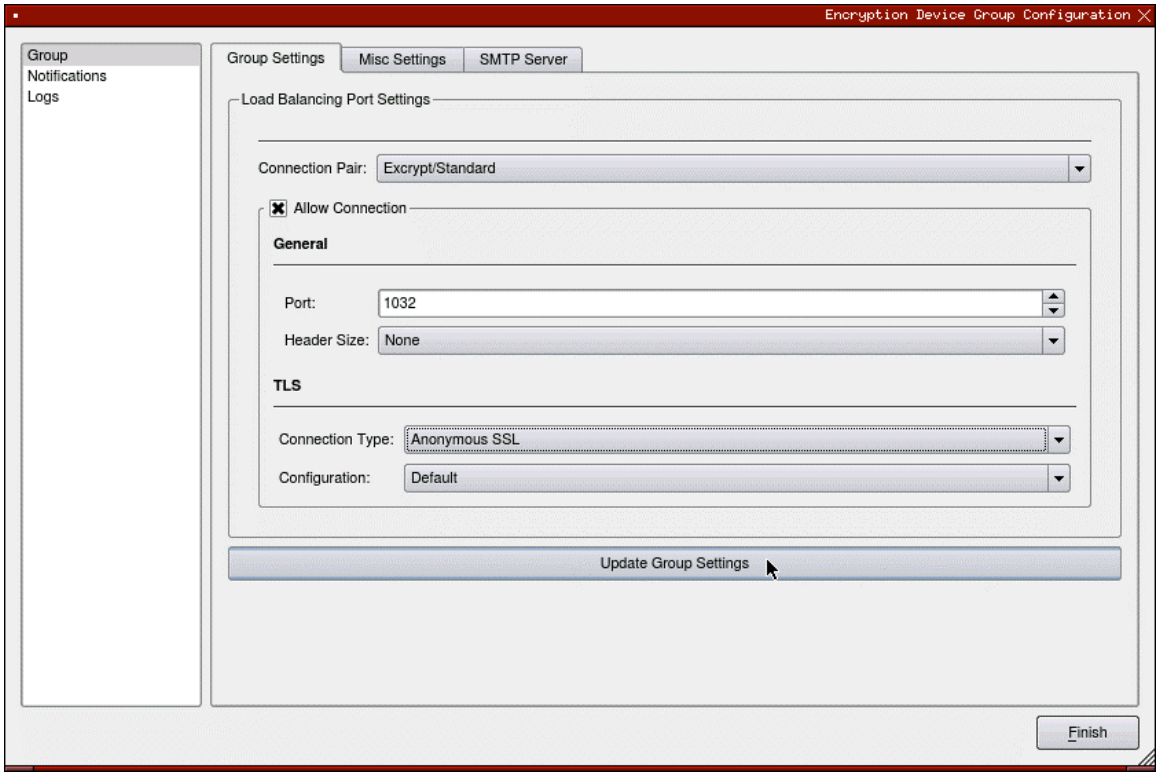


FIGURE: GROUP SETTINGS

You will receive confirmation that the device group settings have been successfully updated. Click "OK", then "Finish", to once again log out of the device group.

Create Connection Certificates for Mutual Authentication (Option 2)

To create client certificates for mutual authentication, refer to section 7.7.

NOTE: Because you're going directly to an HSM to create the client certificates, it may cause the device to drop out of sync. To re-sync, simply log on to the Guardian, right-click on the device, and select "Reconnect…".

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