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**Release Date:** September 2017
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Preface

This document is intended to guide administrators through the steps for Apache HTTP Server and SafeNet Luna HSM integration. This guide provides the necessary information to install, configure, and integrate Apache HTTP Server with SafeNet Luna Hardware Security Modules (HSM).

Scope

This guide provides instructions for setting up a small test lab with Apache HTTP Server running with SafeNet Luna HSM for securing the SSL keys of server. It explains how to install and configure the software that is required for setting up Apache HTTP Server while storing SSL keys on SafeNet Luna HSM.

Document Conventions

This section provides information on the conventions used in this template.

Notes

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

NOTE: Take note. Contains important or helpful information.

Cautions

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

CAUTION: Exercise caution. Caution alerts contain important information that may help prevent unexpected results or data loss.

Warnings

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

WARNING: Be extremely careful and obey all safety and security measures. In this situation you might do something that could result in catastrophic data loss or personal injury.
## Command Syntax and Typeface Conventions

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
</tr>
</thead>
</table>
| **bold**   | The bold attribute is used to indicate the following:  
  - Command-line commands and options (Type `dir /p`.)  
  - Button names (Click **Save As**.)  
  - Check box and radio button names (Select the **Print Duplex** check box.)  
  - Window titles (On the **Protect Document** window, click **Yes**.)  
  - Field names (**User Name**: Enter the name of the user.)  
  - Menu names (On the **File** menu, click **Save**.) (Click **Menu > Go To > Folders**.)  
  - User input (In the **Date** box, type **April 1**.) |
| **italic** | The italic attribute is used for emphasis or to indicate a related document. (See the *Installation Guide* for more information.) |
| Consolas   | Denotes syntax, prompts, and code examples. |
Support Contacts

<table>
<thead>
<tr>
<th>Contact Method</th>
<th>Contact Information</th>
</tr>
</thead>
</table>
| Address                | Gemalto
|                         | 4690 Millennium Drive
|                         | Belcamp, Maryland 21017, USA                            |
| Phone                  | US                                                       |
|                         | 1-800-545-6608                                           |
|                         | International                                           |
|                         | 1-410-931-7520                                           |
| Technical Support      | https://supportportal.gemalto.com                        |
| Customer Portal        | Existing customers with a Technical Support Customer Portal account can log in to manage incidents, get the latest software upgrades, and access the Gemalto Knowledge Base. |
Introduction

Overview

This document covers the necessary information to install, configure, and integrate Apache HTTP Server (provided in Apache Toolkit) with SafeNet Luna HSM.

The SafeNet Luna HSM integrates with the Apache HTTP Server to provide significant performance improvements by off-loading cryptographic operations from the Apache HTTP Server to the SafeNet Luna HSM. In addition, the SafeNet Luna HSM provides extra security by protecting and managing the server's high value SSL private key within a FIPS 140-2 certified hardware security module.

The installation is performed in several steps:

- Install and configure SafeNet Luna HSM.
- Install and configure Apache HTTP Server using SafeNet Luna HSM.

Understanding the Apache

Apache is the most popular web server (after which comes Microsoft's IIS) available. The reasons behind its popularity, to name a few, are:

1. It is free to download and install.
2. It is open source: the source code is visible to anyone and everyone, which basically enables anyone (who can rise up to the challenge) to adjust the code, optimize it, and fix errors and security holes. People can add new features and write new modules.
3. It suits all needs: Apache can be used for small websites of one or two pages, or huge websites of hundreds and thousands of pages, serving millions of regular visitors each month. It can serve both static and dynamic content.

A web server's job is basically to accept requests from clients and send responses to those requests. A web server gets a URL, translates it to a filename (for static requests), and sends that file back over the internet from the local disk, or it translates it to a program name (for dynamic requests), executes it, and then sends the output of that program back over the internet to the requesting party. If for any reason, the web server was not able to process and complete the request, it instead returns an error message. The word, web server, can refer to the machine (computer/hardware) itself, or the software that receives requests and sends out responses.
### 3rd Party Application Details

- Apache HTTP Server v2.4.x for Unix
- Apache HTTP Server v2.2.x for Unix

### Supported Platforms

The following platforms are tested with SafeNet Luna HSM:

<table>
<thead>
<tr>
<th>Operating Systems</th>
<th>SafeNet HSM</th>
<th>Apache Version</th>
</tr>
</thead>
</table>
| Red Hat Enterprise Linux 7.0 (64 bit) | Luna SA Appliance Software v7.0.0  
Firmware 7.0.1  
Luna Client 7.0.0 | Apache v2.4.27 |
| Red Hat Enterprise Linux 7.0 (64 bit) | Luna SA Appliance Software v6.3.0  
Firmware 6.27.0  
Luna Client 6.3.0 | Apache v2.4.27 |
| Red Hat Enterprise Linux 6.9 (64 bit) | Luna SA Appliance Software v5.4.7  
Firmware 6.10.9  
Luna Client 5.4.1 | Apache v2.4.25 |
| Red Hat Enterprise Linux 6.9 (64 bit) | Luna SA Appliance Software v5.4.7  
Firmware 6.10.9  
Luna Client 5.4.2 | Apache v2.4.25 |
| Red Hat Enterprise Linux 6.8 (64 bit) | Luna SA Appliance Software v5.4.7  
Firmware 6.10.9  
Luna Client 5.4.1 | Apache v2.4.25 |
## Operating Systems

<table>
<thead>
<tr>
<th>Operating Systems</th>
<th>SafeNet HSM</th>
<th>Apache Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Hat Enterprise Linux 6.8 (64 bit)</td>
<td>Luna SA Appliance Software v5.4.7 / Firmware 6.10.9 / Luna Client 5.4.2</td>
<td>Apache v2.4.25</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 6.5 (64 bit)</td>
<td>Luna SA Appliance Software v5.4.7 / Firmware 6.10.9 / Luna Client 5.4.1</td>
<td>Apache v2.4.23</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 6.5 (64 bit)</td>
<td>Luna SA Appliance Software v6.2.1 / Firmware 6.10.9 / Luna Client 6.2.1</td>
<td>Apache v2.4.3</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 5.11 (64 bit)</td>
<td>Luna SA Appliance Software v6.2.1 / Firmware 6.10.9 / Luna Client 6.2.1</td>
<td>Apache v2.4.3</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 6.5 (64 bit)</td>
<td>Luna SA Appliance Software v5.4.7 / Firmware 6.21.0 / 6.2.4 / Luna Client 5.4.1</td>
<td>Apache v2.4.4</td>
</tr>
<tr>
<td>Solaris 10 Sparc</td>
<td>Luna SA Appliance Software v5.0.0 / Firmware 6.0.8 / Luna Client 5.0</td>
<td>Apache v2.2.21</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 6.0 (64 bit)</td>
<td>Luna SA Appliance Software v5.2.1 / Firmware 6.10.1 / Luna Client 5.2.1</td>
<td>Apache v2.2.14</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 5.8 (64 bit / 32 bit)</td>
<td>Luna SA Appliance Software v5.0.0 / Firmware 6.0.8 / Luna Client 5.0</td>
<td>Apache v2.2.14</td>
</tr>
<tr>
<td></td>
<td>Luna PCI 5.0 / Firmware 6.1.3</td>
<td></td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 5.8 (64 bit)</td>
<td>Luna SA Appliance Software v5.2.1 / Firmware 6.10.1 / Luna Client 5.2.1</td>
<td>Apache v2.2.14</td>
</tr>
<tr>
<td></td>
<td>Luna SA Appliance Software v4.4.3 / Firmware 4.8.1 / Luna Client 4.4</td>
<td>Apache v2.0.59</td>
</tr>
</tbody>
</table>
Library and Driver Support

- PKCS#11 v2.01 dynamic library
- PKCS#11 v2.20 dynamic library

Prerequisites

SafeNet Network HSM Setup (v4.x/5.x/6.x)

Refer to the SafeNet Network HSM documentation for installation steps and details regarding the configuration and setup of the box on UNIX systems. Before you get started ensure the following:

- SafeNet Network HSM appliance and a secure admin password.
- SafeNet Network HSM, and a hostname, suitable for your network.
- SafeNet Network HSM network parameters are set to work with your network.
- Initialize the HSM on the SafeNet Network HSM appliance.
- Create and exchange certificates between the SafeNet Network HSM and your Client system.
- Create a partition on the HSM, remember the partition password that will be later used by Apache HTTP Server.
- Create and exchange certificate between the SafeNet Network HSM and Client system.
- Enabled Partition "Activation" and "Auto Activation" (Partition policy settings 22 and 23 (applies to SafeNet Network HSM with Trusted Path Authentication [which is FIPS 140-2 level 3] only).

NOTE: For Solaris 10 SPARC, you need to export LD_LIBRARY_PATH. export LD_LIBRARY_PATH=/opt/lunasa/lib:$LD_LIBRARY_PATH

For Solaris 10 SPARC platform in Luna SA v5.0, the general form of the command is /opt/lunasa/bin/vtl verify.

For Luna Client v5.2.1 onwards, the general form of the command is /usr/safenet/lunaclient/bin/vtl verify

Configuring SafeNet Luna Network HSM 7.0

SafeNet Luna Network HSM allows to create Per-Partition Security Officer (PPSO) partition. HSM Administrator is not Security Officer (SO) for PPSO partitions. The HSM SO/Administrator elects to create a partition as PPSO-type, which creates an empty structure that is handed to the new owner, who initializes the partition to create the Partition Security Officer (PSO) role or identity for management functions. The PSO in turn creates the partition Crypto Officer (CO) to control client cryptographic operations on the partition.

Refer to the SafeNet Luna HSM documentation for installation steps and details regarding the configuration and setup of the box on UNIX/Windows systems. Before you get started ensure the following:
- SafeNet Luna Network HSM appliance and a secure admin password.
- SafeNet Luna Network HSM, and a hostname, suitable for your network.
- SafeNet Luna Network HSM network parameters are set to work with your network.
- Initialize the HSM on the SafeNet Luna Network HSM appliance.
- Create and exchange certificates between the SafeNet Luna Network HSM and your Client system.
- Create a partition on the HSM that will be later used by Apache.
- Register the Client with the partition. And run the "vtl verify" command on the client system to display a partition from SafeNet Luna HSM. The general form of command is "c:\Program Files\SafeNet\LunaClient\vtl verify" for Windows and "/usr/safenet/lunaclient/bin/vtl verify" for Unix.
- Initialize the Partition as mentioned in steps below for Password/PED based respectively
- Enabled Partition "Activation" and "Auto Activation" (Partition policy settings 22 and 23 (applies to SafeNet Luna Network HSM with Trusted Path Authentication [which is FIPS 140-2 level 3] only).

Initialize the Partition SO and Crypto Officer Roles on a PW-Auth Partition

These instructions assume a password-authenticated SafeNet Luna Network HSM that has been initialized, and an application partition has been created, capable of having its own Security Officer.

- **Initialize the Partition SO role**

  Set the active slot to the created, uninitialized, application partition:

  Type `slot set -slot <slot number>`

  ```
  lunacm:> slot set -slot 0
  Current Slot Id:    0     (Luna User Slot 7.0.0 (Password) Signing With Cloning Mode)
  Command Result : No Error
  ```

  Initialize the application partition, to create the partition's Security Officer (SO).

  Type `partition init -label <part_label>`

  ```
  lunacm:> par init -label <part_label> -password <part_password>
  You are about to initialize the partition.
  All partition objects will be destroyed.
  Are you sure you wish to continue?
  Type 'proceed' to continue, or 'quit' to quit now -> proceed
  Command Result: No Error
  ```

- **Initialize the Crypto Officer role**

  a. The SO of the application partition can now assign the first operational role within the new partition.

  Type `role login -name Partition SO`.

  ```
  lunacm:> role login -name Partition SO
  ```

  b. Type `role init -name Crypto Officer`.

  ```
  lunacm:> role init -name Crypto Officer
  ```

  c. The application partition SO can create the Crypto Officer, but only the Crypto Officer can create the Crypto User. Therefore, the SO must log out to allow the Crypto Officer to log in.

  Type `role logout`. 

  ```
  lunacm:> role logout
  ```
lunacm:> role logout

**Initialize the Partition SO and Crypto Officer Roles on a PED-Auth Partition**

These instructions assume a PED-authenticated SafeNet Luna Network HSM that has been initialized, and an application partition has been created, capable of having its own Security Officer.

Take the following steps to initialize the PSO and CO roles:

- **Initialize the Partition SO role**
  
  Set the active slot to the created, uninitialized, application partition.
  
  Type `slot set -slot <slot number>`
  
  lunacm:> slot set -slot 0
  
  Current Slot Id: 0 (Luna User Slot 7.0.0 (PED) Signing With Cloning Mode)
  
  Command Result: No Error

  Initialize the application partition, to create the partition’s Security Officer (SO).
  
  Type `partition init -label <part_label>`
  
  lunacm:> par init -label <part_label>
  
  You are about to initialize the partition.
  
  All partition objects will be destroyed.
  
  Are you sure you wish to continue?
  
  Type 'proceed' to continue, or 'quit' to quit now -> proceed
  
  Please attend to the PED.
  
  Respond to SafeNet PED prompts...
  
  Command Result: No Error

- **Initialize the Crypto Officer role**
  
  The SO of the application partition can now assign the first operational role within the new partition.
  
  Type `role login -name Partition SO`.
  
  Type `role init -name Crypto Officer`.
  
  lunacm:> role init -name Crypto Officer
  
  Please attend to the PED.
  
  Respond to SafeNet PED prompts...
  
  Command Result: No Error

  The application partition SO can create the Crypto Officer, but only the Crypto Officer can create the Crypto User. Therefore, the SO must log out to allow the Crypto Officer to log in.
  
  Type `role logout`.

  Now, the Crypto Officer, or an application using the CO’s challenge secret/password can perform cryptographic operations in the partition, as soon as the Crypto Officer logs in with `role login -name Crypto Officer`.
  
  However, the Crypto Officer can create, modify and delete crypto objects within the partition, in addition to merely using existing crypto objects (sign/verify). You can also create a limited-capability role called Crypto User that can use the objects created by the Crypto Officer, but cannot modify them.

---

**NOTE:** The black Crypto Officer PED key/Crypto Officer Password (in case of PW-Auth) is valid for the initial login only. You must change the initial credential on the key using the command `role changepw` during the initial
login session, or a subsequent login. Failing to change the credential will result in a CKR_PIN_EXPIRED error while performing role-dependent actions.

Controlling User Access to the HSM

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 your client software while retaining your hsmusers group configuration.

Adding users 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. Users you add to the hsmusers group are able to access the HSM. Users who are not part of the hsmusers group are not able to access the HSM.

- **Adding a user to hsmusers group**
  
  For Apache-toolkit to work with Luna7 add daemon user to hsmusers group.
  
  a. Ensure that you have sudo privileges on the client workstation.
  
  b. Add a user to the hsmusers group.

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

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

Removing users from hsmusers group

To revoke a user's access to the HSM, you can remove them from the hsmusers group.

- **Removing a user from hsmusers group**
  
  a. Ensure that you have sudo privileges on the client workstation.
  
  b. Remove a user from the hsmusers group.

  ```bash
  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.

SafeNet PCI-E HSM Setup

Refer to the SafeNet PCI documentation for installation steps and details regarding configuring and setting up the box on RHEL and Solaris SPARC systems. Before you get started ensure the following:

- Initialize the HSM on the SafeNet PCI appliance.
- Create a partition on the HSM that will be later used by the Apache HTTP Server.
• Enable Partition "Activation" and "Auto Activation" (Partition policy settings 22 and 23 (applies to Luna PCI with Trusted Path Authentication [which is FIPS 140-2 level 3] only).

SafeNet Network HSM Configuration Settings

When Luna Client is installed a configuration file is loaded at the following location:

/etc/Chrystoki.conf

This file is automatically configured and do not require any changes to communicate with the HSM.

However for Luna Client 6.x onwards we have to edit this configuration file for slot id because by default it is 0 but LunaCA3 engine/GemEngine configured to use slot id as 1. You need to set the slot id to 1 by making the following changes in configuration file:

Presentation = {
    OneBaseSlotId =1;
}

Another major change in Luna (firmware 6.22.0 or above) for FIPS mode, Under FIPS 186-3/4, the only RSA methods permitted for generating keys are 186-3 with primes and 186-3 with aux primes. This means that RSA PKCS and X9.31 key generation is no longer approved for operation in a FIPS-compliant HSM. So if you are using the HSM in FIPS mode you have to make the following change in configuration file:

Misc = {
    RSAKeyGenMechRemap = 1;
}

Above setting “RSAKeyGenMechRemap” will redirect the older calling mechanism to new approved mechanism when HSM is in FIPS mode for firmware 6.22.0 or above.

NOTE: The above configuration is valid for Luna 7.0 and Luna 6.x (F/W Version 6.22.0 and above only).

Apache Toolkit

The APACHE toolkit is provided to make the installation quick and easy. The latest installation CD can be obtained from the Customer Connection Center.

APACHE toolkit installs by default the apache version that was built with the toolkit. However you can use any version of Apache with our toolkit which is described in Chapter 2. You can skip the Chapter 2 if you need to install Apache version provided with toolkit anyway.

NOTE: If you already have Apache installed, uninstall it before proceeding with the installation.

This toolkit is used for LunaCA3 Engine. However, for GemEngine it is not needed.
GemEngine Toolkit

The GemEngine toolkit is provided to integrate Apache HTTP Server with SafeNet HSM. The installation CD can be obtained from the SafeNet Customer Support.

NOTE: For GemEngine v1.2 setup, contact Customer support.
Doc IDs for GemEngine v1.2 is DOW0002177/KB0016309.
Configuring Apache Toolkit for v2.x.x (An Example)

This is an example of how to use the version of Apache Server that is not build in Apache Toolkit by default. To configure Apache HTTP Server 2.x.x to recognize the SafeNet Network HSM / SafeNet PCI-E HSM cryptographic device:

1. Download the desired version from the following site:
   http://archive.apache.org/dist/httpd/
   
   NOTE: We have tested below steps with Apache (v2.2.21, v2.4.3, v2.4.23) but you can use any v2.x.x available.

2. Traverse to toolkit, e.g. /root/_cdrom_apache.
3. Copy and paste the httpd-2.x.x.tar.gz, downloaded from the above site.
4. Extract the luna-samples-0.9.8 from luna-samples-0.9.8.tar.gz by using the following commands:
   
   ```
   # gunzip luna-samples-0.9.8.tar.gz
   # tar -xvf luna-samples-0.9.8.tar
   ```
5. Copy existing configuration files and save the with the name of version you want to build, using the following commands:
   
   ```
   # cd luna-samples-0.9.8
   # For Apache v2.2.x
   # cp httpd-luna-2.2.14.conf httpd-luna-2.2.x.conf
   # cp mpm-luna-2.2.14.conf mpm-luna-2.2.x.conf
   # cp ssl-luna-2.2.14.conf ssl-luna-2.2.x.conf
   # For Apache v2.4.x
   # cp httpd-luna-2.4.4.conf httpd-luna-2.4.x.conf
   # cp mpm-luna-2.4.4.conf mpm-luna-2.4.x.conf
   # cp ssl-luna-2.4.4.conf ssl-luna-2.4.x.conf
   ```
6. Now zip the luna-samples-0.9.8 folder as it was originally using the following commands:
   
   ```
   # tar -cvf luna-samples-0.9.8.tar luna-samples-0.9.8/*
   # gzip luna-samples-0.9.8.tar
   ```
7. Traverse to toolkit, e.g. /root/_cdrom_apache.
8. Edit the abuild-2.x script for apache version, change the APACHEVER="2.2.14" or APACHEVER="2.4.4" as APACHEVER="2.x.x"

9. Save the abuild-2.x script after changing the version you want to install.

Now you have completed all the changes required to integrate Apache v2.x.x with Luna SA. Follow the steps mentioned in the next Chapter.
Integration of Apache Server with SafeNet Luna HSM Using LunaCA3 Engine

Apache Installation and Configuration

To configure Apache HTTP Server to recognize the SafeNet Network HSM / SafeNet PCI-E HSM cryptographic device:

1. Traverse to toolkit, e.g. /root/_cdrom_apache.
2. Run the OptimizeApache.sh to configure the SafeNet Network HSM / SafeNet PCI-E HSM configuration file (/etc/Chrystoki.conf) for APACHE:
   
   ```bash
   # ./OptimizeApache.sh fork
   ```
   
   For further information, refer to the README-OPTIMIZE under the APACHE toolkit.
3. The SafeNet Network HSM / SafeNet PCI-E HSM configuration file (/etc/Chrystoki.conf) is now configured for Apache HTTP Server.

**SafeNet Network HSM**

```
Misc = {
    PE1746Enabled = 0;
    Apache = 0;
}
```

```
EngineLunaCA3 = {
    LibPath = /usr/safenet/lunaclient/lib/libCryptoki2.so;
    LibPath64 = /usr/safenet/lunaclient/lib/libCryptoki2_64.so;
    EngineInit = 1:10:11;
    DisableRand = 1;
    DisableDsa = 1;
    DisableEcdsa = 1;
    DisableCheckFinalize = 0;
    EnableRsaGenKeyPair = 0;
    EnableDsaGenKeyPair = 0;
}
```
NOTE: Make sure that the value of LibPath and LibPath64 should be the path of libCryptoki2.so or libCryptoki2_64.so respectively in /etc/Chrystoki.conf after running OptimizeApache.sh script. Path of Cryptoki library has been changed in Luna 5.2.1 onwards.

SafeNet PCI-E HSM

Misc = {
    Apache = 1;
    PE1746Enabled=1;
}

EngineLunaCA3 = {
    DisableCheckFinalize = 0;
    DisableEcdsa = 1;
    DisableDsa = 1;
    DisableRand = 1;
    EngineInit = 1:10:11;
    LibPath64 = /usr/lunapci/lib/libCryptoki2_64.so;
    LibPath = /usr/lunapci/lib/libCryptoki2.so;
}

4. Traverse to the toolkit: /root/_cdrom_apache, run the configuration script (abuild-2.x) to install Apache HTTP Server and Open SSL for Luna SA with

For (32-bit):

# LUNA_CONFIG_BITS=32
# LUNA_CONFIG_BITS=32 ./abuild-2.x --build

For (64-bit):

# LUNA_CONFIG_BITS=64
# LUNA_CONFIG_BITS=64 ./abuild-2.x --build

For further information, refer to the README-ABUILD under the APACHE toolkit.

5. Open a session to SafeNet Luna HSM using the sautil utility provided under the /usr/local/sautil/bin:

# sautil -v -s 1 -i 10:11 -o -q

For further information, refer to the README-RSA under the APACHE toolkit.

6. Enter the partition password of the HSM in which you have registered the APACHE server as a client.

7. Traverse to the toolkit: /root/_cdrom_apache, run the abuild-2.x script to generate keys on the SafeNet Luna HSM.

For (32-bit):

# LUNA_CONFIG_BITS=32 ./abuild-2.x --genrsa
For (64-bit):

```
# LUNA_CONFIG_BITS=64 ./abuild-2.x --genrsa
```

Enter the relevant information as prompted for the keys to be generated.

8. Traverse to apache installation directory:

```
# cd /usr/local/apache2/conf
```

9. Open the apache configuration file (httpd.conf) and edit the ServerName field with the hostname or IP address of the server.

10. Traverse to the directory:

```
# cd /usr/local/apache2/conf/extra
```

11. Open the ssl configuration file (httpd-ssl.conf) and edit the Virtual Host section as below:

```
<Virtual Host Hostname or IP Address: 443>
```

12. Traverse to the directory:

```
# cd /usr/local/apache2/bin
```

13. Start the Apache HTTP Server with the SSL option:

```
# ./apachectl -DSSL
```

or

```
# ./apachectl -k (stop/start/restart)
```

Make sure you have disabled iptables or allow http/https traffic through firewall.

14. Open any browser (IE/Firefox) and access the HTTP Server:

```
https://<HostName or IP Address>:443
```

15. Accept the certificate.
Integration of Apache Server with SafeNet Luna HSM Using GemEngine

Apache Installation and Configuration

OpenSSL must be configured and integrated with GemEngine v1.2.

1. Download and extract OpenSSL source tarball.
   Example:
   Download openssl-1.0.1s.tar.gz from https://www.openssl.org/source/
   # tar xvfz openssl-1.0.1s.tar.gz

2. Download and extract OpenSSL FIPS module. Ignore this step if FIPS module is not required.
   Example:
   Download openssl-fips-2.0.9.tar.gz from https://www.openssl.org/source/
   # tar xvfz openssl-fips-2.0.9.tar.gz

3. Download and extract an apache(httpd) source tarball from https://httpd.apache.org/download.cgi
   and place the .tar.gz file inside the gemengine directory.
   Example:
   Download httpd-2.4.27.tar.gz and extract:
   tar xzvf httpd-2.4.27.tar.gz

4. Download and extract an apr source tarball from https://apr.apache.org/download.cgi
   and place the .tar.gz file inside the gemengine directory.
   Example:
   Download apr-1.6.2.tar.gz and extract:
   tar xzvf apr-1.6.2.tar.gz

5. Download and extract an apr util source tarball from https://apr.apache.org/download.cgi
   and place the .tar.gz file inside the gemengine directory.
   Example:
   Download apr-util-1.6.0.tar.gz and extract:
   tar xzvf apr-util-1.6.0.tar.gz

6. Download and extract an apr iconv source tarball from https://apr.apache.org/download.cgi
   and place the .tar.gz file inside the gemengine directory.
Example:

Download apr-icnv-1.2.1.tar.gz and extract:

tar xzvf apr-icnv-1.2.1.tar.gz

7. Run `gembuild config` using the `--prefix` option.

```
# ./gembuild config --openssl-source=<openssl-source-path> --apache-source=<httpd-src-path> --apr-source=<apr-src-path> --apr-icnv-source=<icnv-src-path> --apr-util-source=<util-src-path> --prefix=/usr/local --config-bits=64
```

If FIPS module is required, add "--openssl-fips-source=<openssl-fips-source-path>" to the "./gembuild config" command.

8. Compile and install FIPS module. Proceed to STEP 9 if FIPS module is not required.

```
# ./gembuild openssl-fips-build
# ./gembuild openssl-fips-install
```

9. Compile and install OpenSSL.

```
# ./gembuild openssl-build
# ./gembuild openssl-install
```


```
# ./gembuild engine-build
# ./gembuild engine-install

# /usr/local/ssl/bin/openssl engine gem -v

(gem) Gem engine support

enginearg, openSession, closeSession, login, logout, engineinit,
CONF_PATH, ENGINE_INIT, ENGINE2_INIT, engine2init, DisableCheckFinalize,
SO_PATH, GET_HA_STATE, SET_FINALIZE_PENDING, SKIP_C_INITIALIZE
```

11. Compile and install sautil command.

```
# ./gembuild sautil-build
# ./gembuild sautil-install
```

By default this installs the sautil command to ":/prefix>/sautil/bin/sautil" where <prefix> is the directory specified with --prefix option in the step 7.

If a different location is desired, use the --sautil-prefix option to specify the desired directory either by redoing the step 7 with the option or by specifying the option as part of the "./gembuild sautil-install" command.

12. Add openssl and sautil to PATH

Example:

```
# export PATH=/usr/local/ssl/bin:/usr/local/sautil/bin:$PATH
```

13. Compile and install apache

```
./gembuild apache-build
```

14. Run the Optimize.sh in the gemengine directory to configure the SafeNet Network HSM / SafeNet PCI-E HSM configuration file (/etc/Chrystoki.conf) for APACHE:

```
#./Optimize.sh fork
```
The SafeNet Network HSM / SafeNet PCI-E HSM configuration file (/etc/Chrystoki.conf) is now configured for Apache HTTP Server.

**SafeNet Network HSM**

```plaintext
Misc = {
    PE1746Enabled = 0;
    Apache = 0;
}
GemEngine = {
    LibPath = /usr/safenet/lunaclient/lib/libCryptoki2.so;
    LibPath64 = /usr/safenet/lunaclient/lib/libCryptoki2_64.so;
    EnableDsaGenKeyPair = 1;
    EnableRsaGenKeyPair = 1;
    DisablePublicCrypto = 1;
    EnableRsaSignVerify = 1;
    EnableLoadPubKey = 1;
    EnableLoadPrivKey = 1;
    DisableCheckFinalize = 1;
    DisableEcdsa = 1;
    DisableDsa = 0;
    DisableRand = 0;
    EngineInit = 1:10:11;
}
```

15. Run the sautil utility to open the session on SafeNet Luna HSM slot.

```
# /usr/local/sautil/bin/sautil -v -s 1 -i 10:11 -o -q
```

16. Generate RSA key pair using Apache Toolkit

```
./gembuild apache-genrsa
```

17. Traverse to apache installation directory, update apache configuration file (httpd.conf) and edit the ServerName field with the hostname or IP address of the server with the value specified for the CN in the certificate created in step 16.

18. Traverse to apache installation directory for extra configuration (for e.g. /usr/local/apache2/conf/extra), update httpd-ssl.conf and edit the Virtual Host section as below:

```
#<Virtual Host Hostname or IP Address: 443>
```

19. Start the Apache server

```
/usr/local/apache2/bin/apachectl -k start
```
20. Open any browser (IE/Firefox) and access the HTTP Server:
   
   https://<HostName or IP Address>:443

21. Accept the certificate.