

Sentinel LDK 9.0 with Sentinel EMS

INSTALLATION GUIDE



Revision History

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Preface

This guide describes how to install all required components of Sentinel LDK.

About This Guide

The guide contains the sections described below.

What's Included in Sentinel LDK

- > ["Sentinel LDK Software Package" on page 7](#)

Describes the Sentinel LDK software package.

Installing Sentinel LDK

- > ["Installing Sentinel LDK with Sentinel EMS \(Thales-Hosted\)" on page 10](#)

For companies who subscribe to Sentinel EMS (hosted by Thales), describes how to install and configure the required Sentinel LDK components.

Setting Up Cloud Licensing

- > ["Configuring High Availability for Cloud Licensing" on page 26](#)

For companies who work with Sentinel LDK-EMS and want to host a license server for cloud licensing, describes how to configure their server for high availability.

Configuring Sentinel LDK to Recognize Your Vendor Code

- > ["Introducing Your Sentinel Vendor Keys to Sentinel LDK" on page 15](#)

Describes how to introduce your Sentinel Vendor keys to the Sentinel LDK system. This ensures that your applications are protected and licensed with the unique codes that have been assigned to you.

Installing Sentinel LDK Run-time Environment

- > ["Installing Sentinel LDK Run-time Environment for Mac" on page 47](#)

Describes how to install the Sentinel LDK Run-time Environment on a machine with a Mac operating system.

- > ["Installing Sentinel LDK Run-time Environment for Linux" on page 51](#)

Describes how to install the Sentinel LDK Run-time Environment on a machine with a Linux operating system.

- > ["Installing Sentinel LDK Run-time Environment for Windows" on page 56](#)

Describes additional options for installing Sentinel LDK Run-time Environment.

Post-Installation Software Updates

- > ["Installing Software Updates" on page 59](#)

This section describes how the Sentinel LDK software manager checks for software updates to ensure that you are always working with the latest version of Sentinel LDK.

- > ["Modifying and Uninstalling Sentinel LDK Components" on page 61](#)

Describes how to completely uninstall Sentinel LDK.

Training

For additional information and training about Sentinel LDK implementation issues, contact [our team](#) of international consultants who can provide you with tailored training sessions on the following:

- > Integration of Sentinel LDK into your product
- > Analysis of the best protection strategy for your applications
- > Assistance in implementation of your protection and licensing models

CHAPTER 1: Sentinel LDK Software Package

The software described in this section is hosted on Thales servers or is provided in the Sentinel LDK installation package (except where noted).

NOTE FOR MAC AND LINUX This document describes how to install Sentinel LDK on a Windows platform. To set up Sentinel LDK Vendor Tools on a Mac or Linux platform, see [Sentinel LDK Getting Started Guide for Mac](#) or [Sentinel LDK Getting Started Guide for Linux](#).

Sentinel EMS—Entitlement Management System

Sentinel EMS is a back-office server application that enables you to define, produce and update Sentinel protection keys and to define and process entitlements (customer orders).

Sentinel EMS is an enterprise-level version entitlement management system that provides an advanced user interface and REST API to manage resources. Sentinel EMS supports multiple methods of enforcement, including custom and third-party enforcement types. Sentinel EMS REST API enables you to integrate the entitlement and production functionality of Sentinel EMS in your own back-office management software. For details, see <https://docs.sentinel.thalesgroup.com/softwareandservices/ldk/default.htm>.

You subscribe to Sentinel EMS as a service from Thales. Thales installs a dedicated instance of Sentinel EMS for your organization and sets up the Sentinel EMS database on its own servers.

The instance of Sentinel EMS can be accessed throughout your organization using web browsers. The Sentinel EMS database contains all the licensing and entitlement information for your customers.

Sentinel LDK Vendor Suite

Sentinel LDK Vendor Suite is used by software developers and consists of the elements described below.

Vendor Tools

Vendor Tools are installed on the developers' machines and are used to implement protection and licensing for your applications. The most-used Sentinel LDK Vendor Tools are:

> Sentinel LDK Envelope

Applies security to your software within a protective shield. Available for Windows, Mac, and Linux platforms.

> Sentinel LDK ToolBox

Enables you to familiarize yourself with the Sentinel Licensing API and to generate code to include in your software's source code. Available for Windows platforms.

Sentinel LDK APIs

Sentinel LDK APIs are installed on developers' machines or are included in protected applications. The provided APIs are as follows:

> Sentinel Licensing API

Enables you to protect your application by inserting calls to a Sentinel protection key throughout your source code.

On the machine where Sentinel LDK Vendor Tools are installed, a **Sample** folder contains samples for various compilers and programming languages. Each sample includes:

- Libraries that must be linked to your application
- A sample application that demonstrates the use of the API

Sample folders are also provided in the Sentinel LDK directory structures for Linux and macOS.

These samples enable you to integrate protection into your own software using a variety of programming languages.

> Sentinel Admin API

Sentinel Admin API provides the functionality available in Admin Control Center and Admin License Manager in the form of callable API functions. You can call functions to retrieve information from local or remote License Managers and to perform actions in these License Managers.

> Sentinel Run-time Installer API

The functions in this API can be used to integrate the installation of the Sentinel LDK Run-time Environment into your custom setup application.

For links to these API references, see:

<https://docs.sentinel.thalesgroup.com/softwareandservices/ldk/default.htm>

Sentinel LDK Run-time Environment

Sentinel LDK Run-time Environment is the main link between a Sentinel protection key and a protected application or data file following its deployment at a customer's site. Depending on the type of protection key used, end users may need to have Sentinel LDK Run-time Environment installed in order to run the protected application or to access a protected data file.

You can integrate the Sentinel LDK Run-time Environment installer into the installation of your protected application.

Sentinel LDK Run-time Environment is also required by Sentinel LDK Vendor Tools and by Sentinel EMS and Sentinel LDK-EMS to update protection keys. The Sentinel LDK Installer installs the Run-time Environment on your machines when you install any of the Sentinel LDK components.

Sentinel Admin Control Center is included in the Run-time Environment. Sentinel Admin Control Center is a customizable, Web-based, vendor and end-user utility that enables centralized administration of Sentinel License Managers and Sentinel protection keys.

Use Sentinel Admin Control Center to monitor licenses and sessions when a protected application or data file is operating, to manage cloud licensing, and to manage detachable licenses.

For links to the Sentinel LDK Run-time Environment readme files, see:

<https://docs.sentinel.thalesgroup.com/softwareandservices/ldk/default.htm>

CHAPTER 2: Installing Sentinel LDK

This section describes how to install Sentinel LDK with an entitlement management system, as described in ["Sentinel EMS—Entitlement Management System" on page 7](#).

From the deployments listed below, install the one that corresponds to the entitlement management system to which you subscribed.

In this section:

> ["Installing Sentinel LDK with Sentinel EMS \(Thales-Hosted\)" below](#)

For companies who subscribe to Sentinel EMS (hosted by Thales), describes how to install and configure the required Sentinel LDK components.

Installing Sentinel LDK with Sentinel EMS (Thales-Hosted)

This section is intended for vendors who want to work with Sentinel LDK and have subscribed to Sentinel EMS, which is hosted on Thales servers.

This section describes how to install Sentinel LDK on a Windows machine, including a launcher for Sentinel EMS.

For a description of the various components that comprise Sentinel LDK, see ["Sentinel LDK Software Package" on page 7](#).

The following procedures are described:

> ["Installing Sentinel LDK Vendor Suite with Sentinel LDK Launcher" below](#)

This procedure describes how to install Sentinel LDK Vendor Suite with the Sentinel LDK launcher for starting Sentinel EMS.

> ["Installing a Launcher for Sentinel EMS" on page 12](#)

This procedure describes how to install the Sentinel LDK launcher for starting Sentinel EMS.

> ["Configuring Sentinel LDK to Work With Sentinel EMS" on page 14](#)

This procedure describes how to set the Sentinel EMS URL for integration with Sentinel LDK.

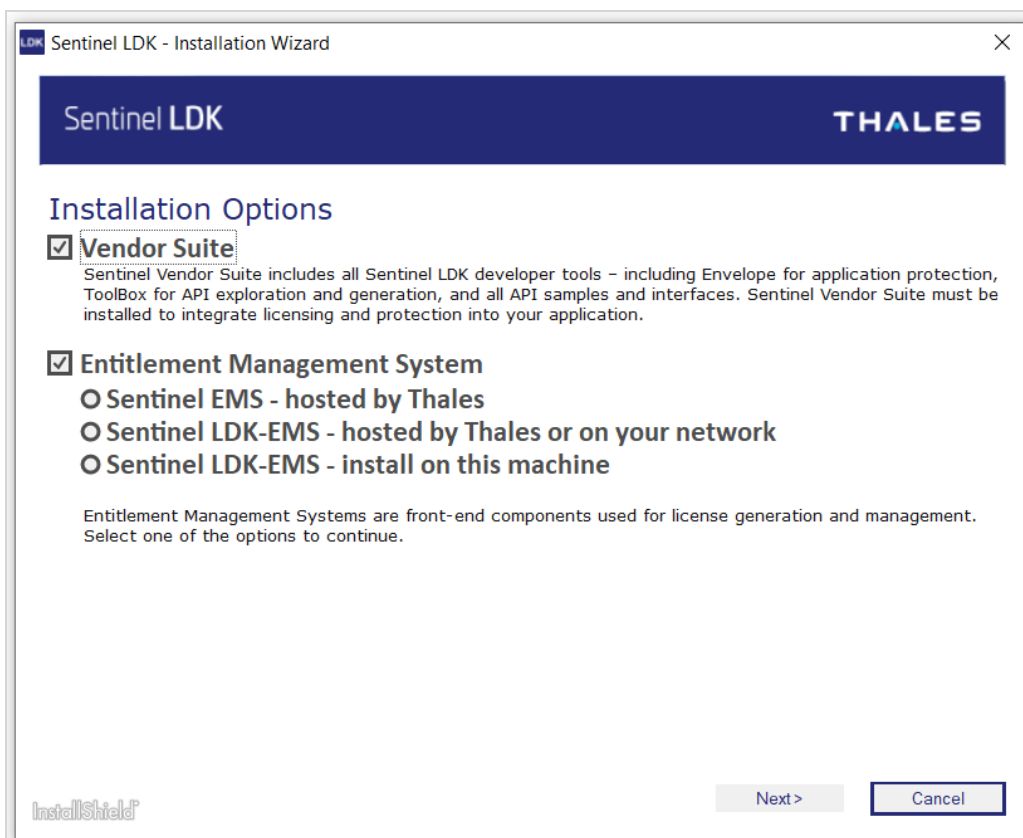
Installing Sentinel LDK Vendor Suite with Sentinel LDK Launcher

Follow the instructions below to install Sentinel LDK Vendor Suite with a Sentinel LDK launcher for starting Sentinel EMS.

(Otherwise, if you want to install only a Sentinel LDK launcher for starting Sentinel EMS, go to ["Installing a Launcher for Sentinel EMS" on the next page.](#))

To install Sentinel LDK Vendor Suite with a Sentinel LDK launcher:

1. Ensure that you do not have any Sentinel Vendor keys or Sentinel HL keys connected to your machine.
2. Go to [Thales Customer Support Portal for Sentinel LDK](#).
3. In the **Product Versions** box, click **9.0 SDK**.
4. Download **Sentinel-LDK_SDK_Windows.zip** and unzip the installation package to a temporary folder on your machine.
5. Browse to the **Windows** folder and double-click **setup.exe**.
6. Click **Start the Sentinel LDK Setup**. The Sentinel LDK Installation Wizard welcome window is displayed.
7. Click **Next**. You are asked to accept the license agreement.
8. Accept the agreement and click **Next**. The Installation Options screen is displayed:



9. Ensure that the following options are selected:
 - **Vendor Suite**

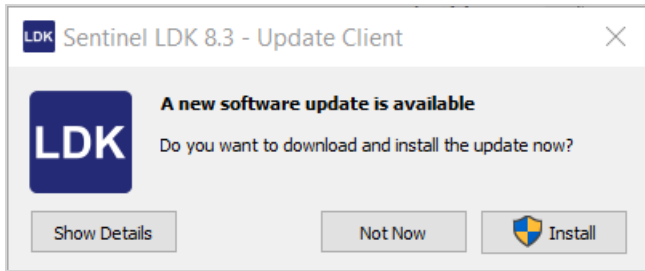
Entitlement Management System

– Sentinel EMS – hosted by Thales

Click **Next**.

10. Follow the instructions to install Sentinel LDK Vendor Suite.

After the Installation Wizard has completed, Sentinel LDK Software Manager checks automatically to determine if a later version of any of the Sentinel LDK software is available. If a later version is found, a message similar to the following is displayed:



11. You can click **Install** to install the update. For more information regarding this message, see ["Installing Software Updates" on page 59](#).

12. When the installation process is completed: Configure the Sentinel LDK launcher to start Sentinel EMS as described in ["Configuring Sentinel LDK to Work With Sentinel EMS" on page 14](#).

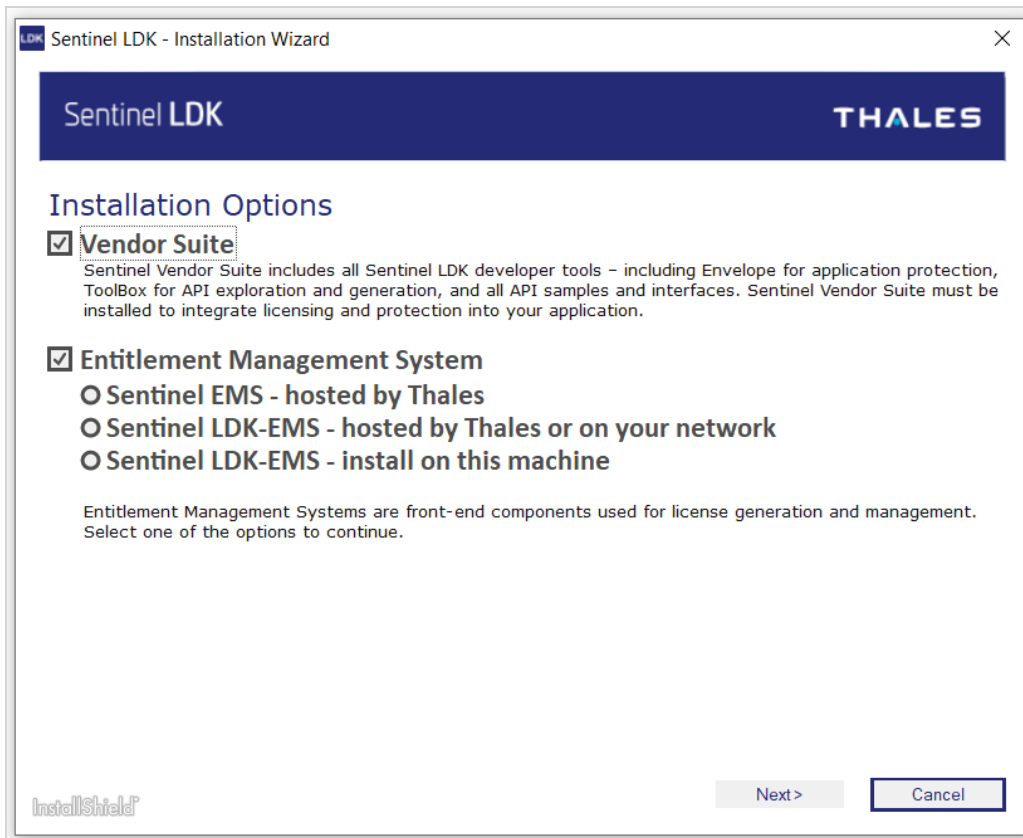
Installing a Launcher for Sentinel EMS

If you are not installing Sentinel Vendor Suite on the machine, use the procedure below to install a Sentinel LDK launcher for starting Sentinel EMS.

(Otherwise, if you want to install both Sentinel LDK Vendor Suite and a Sentinel LDK launcher for starting Sentinel EMS, go to ["Installing Sentinel LDK Vendor Suite with Sentinel LDK Launcher" on page 10](#).)

To install a launcher for Sentinel EMS:

1. Ensure that you do not have any Sentinel Vendor keys or Sentinel HL keys connected to your machine.
2. Go to [Thales Customer Support Portal for Sentinel LDK](#).
3. In the **Product Versions** box, click **9.0 SDK**.
4. Download **Sentinel-LDK_SDK_Windows.zip** and unzip the installation package to a temporary folder on your machine.
5. Browse to the **Windows** folder and double-click **setup.exe**.
6. Click **Start the Sentinel LDK Setup**. The Sentinel LDK Installation Wizard welcome window is displayed.
7. Click **Next**. You are asked to accept the license agreement.
8. Accept the agreement and click **Next**. The Installation Options screen is displayed:



9. Ensure that only the following options are selected:

- **Entitlement Management System**
 - **Sentinel EMS – hosted by Thales**

Click **Next**.

10. Follow the instructions to install the Sentinel LDK launcher.

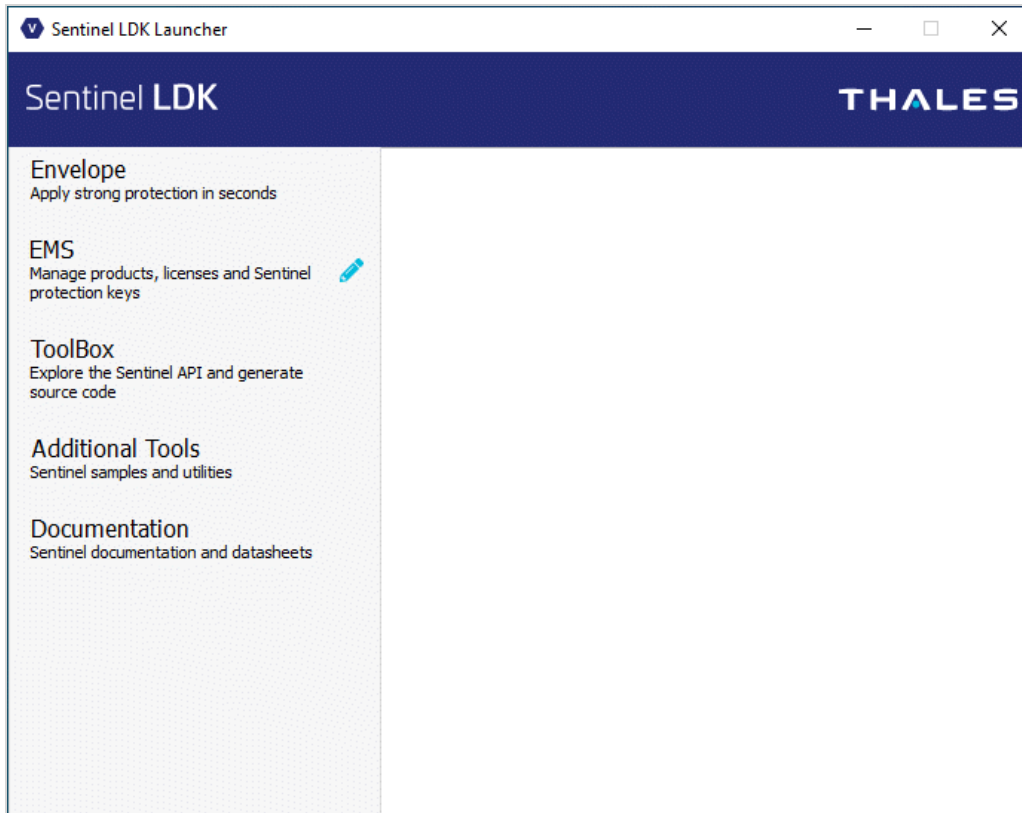
11. When the installation process has completed: Configure the Sentinel LDK launcher to start Sentinel EMS as described in ["Configuring Sentinel LDK to Work With Sentinel EMS" on the next page](#).


Configuring Sentinel LDK to Work With Sentinel EMS

Follow the instructions below to configure Sentinel LDK to work with Sentinel EMS on a Windows machine.

To configure Sentinel LDK to work with Sentinel EMS:

1. From the Start menu, select **Thales > Sentinel LDK**. The Sentinel LDK Launcher is displayed.



2. Set the Sentinel EMS URL.
 - a. In the navigation pane, next to **Sentinel EMS**, click the edit button . The Set Up Access to Sentinel EMS screen is displayed.
 - b. Enter the URL for Sentinel EMS and click **Save**.
3. Set the Sentinel EMS URL for Sentinel Admin Control Center.
 - a. From the navigation pane, click **Additional Tools > Admin Control Center**. Sentinel Admin Control Center opens.
 - b. In the Options pane, click **Configuration**. The Configuration page is displayed.
 - c. From the top of the page, click the **Network** tab. The Network page is displayed.
 - d. In the **EMS URL** field, add the URL for Sentinel EMS. (Do not overwrite any existing URLs in the field.)
 - e. Click **Submit**.

CHAPTER 3: Introducing Your Sentinel Vendor Keys to Sentinel LDK

When you order Sentinel protection keys from Thales, you are assigned a unique Batch Code. Your Batch Code represents your unique confidential Vendor Code.

Your Sentinel LDK Starter Kit contains a Sentinel LDK Master key and a Sentinel LDK Developer key (referred to collectively as *Sentinel Vendor keys*). Each Sentinel Vendor key contains your unique Vendor Code.

You must "introduce" one of your Vendor keys to Sentinel LDK using the Sentinel LDK Master Wizard. Introducing a Vendor key means running the Master Wizard on a machine that has access to the Vendor key. This enables the Master Wizard to perform a number of important functions as described in ["Master Wizard Functions" on the next page](#).

If you have multiple Batch Codes, you must introduce one of your Vendor keys for each Batch Code.

You must introduce one of your Sentinel Vendor keys to the system:

- > Before you use Sentinel LDK Vendor Suite for the first time.
- > After each time you upgrade to a new version of Sentinel LDK.

This ensures that your applications are protected and licensed with the unique codes that have been assigned to you and that you are working with the latest APIs and libraries.

NOTE The Sentinel LDK Master key is not required when working with Sentinel EMS. Vendors who are working with Sentinel EMS can handle all functions using the Sentinel LDK Developer key.

For more information about Batch Codes, see the description of personalized Vendor and Batch Codes in the [Sentinel LDK Software Protection and Licensing Guide](#).

In this section:

- > ["Master Wizard Functions" on the next page](#)
- > ["Methods of Introducing a Vendor Key" on the next page](#)
- > ["Remote Connection of Vendor Keys" on page 17](#)
- > ["Selecting the Version-Enforcement Option" on page 17](#)
- > ["Using the Master Wizard to Introduce a Sentinel Vendor Key" on page 19](#)

Master Wizard Functions

This section describes the functions performed by the Master Wizard and the machines on which the Master Wizard must be run for each function.

The Master Wizard performs one or more of the following:

> Download vendor-specific APIs and the vendor library

The wizard downloads vendor-specific APIs and the vendor library from Thales servers. These are generated individually for each Batch Code and are used by Sentinel LDK Envelope and Licensing API to implement license enforcement.

Run the Master Wizard on each machine where you have installed Vendor Suite.

Run the wizard before you start working with Sentinel LDK-EMS. Thales recommends that you run the Master Wizard after each new release of Sentinel LDK.

> Generate customized RTE installers

NOTE To generate the customized RTE installers for Mac and for Linux, use the Windows version of the Master Wizard.

The wizard downloads Run-time Environment (RTE) installers from Thales servers and customizes them on your machine. The Master Wizard customizes the installers by embedding your vendor library and the server address for Sentinel EMS or Sentinel LDK-EMS.

The installers are saved to:

%UserProfile%\Documents\Thales\Sentinel LDK <version>\Redistribute\Runtime Environment

These installers can be distributed to:

- Customers who require the Run-time Environment to access protection keys.
- (Under Windows) Customers who will use the Sentinel LDK-EMS Customer Portal to activate or update licenses.

Run the Master Wizard on any machine where the Sentinel LDK launcher is installed.

Thales recommends that you run the Master Wizard after each new release of Sentinel LDK or of the Run-time Environment.

Methods of Introducing a Vendor Key

You can introduce your Vendor key using either of the following methods:

> Download over the Internet

Using this method, the Master Wizard connects to the Thales server over the Internet and downloads the required files to your machine. This is the easiest method.

> **Extraction from a Master Wizard Package**

If the machine where you want to introduce a Vendor key cannot connect to the Internet, you can request a Master Wizard Package (MWP) file from Thales customer services. You will receive an MWP file that was generated specifically for your Batch Code and contains all of your customized libraries and RTE installers. The Master Wizard reads this file and extracts the libraries and installers that you select.

You select your preferred method of introduction when you run the Master Wizard.

Remote Connection of Vendor Keys

Sentinel Developer keys can be connected remotely using available third-party solutions. These solutions can be used in cases where a physical key cannot be connected due to the lack of a USB port or inability to physically access the machine. You can connect your Developer keys to an over-the-network USB solution and access them from any physical or virtual machine as if they were connected locally.

There are several such solutions, both software-based (that can be installed on any PC with a USB port) and dedicated devices. Among the dedicated devices, Thales recommends utnserver Pro, myUTN-2500, dongleserver Pro, and dongleserver ProMAX by SEH Technology. These devices were tested for Thales Sentinel HL keys, and are backed by partnership between SEH Technology and Thales.

Selecting the Version-Enforcement Option

API libraries that are customized for your Batch Code are used by Sentinel LDK Envelope and Sentinel Licensing API to protect your applications. These libraries are generated by Thales specifically for your Batch Code. You download these customized vendor libraries using the Master Wizard when you introduce your Vendor keys.

The Master Wizard offers you a choice of two types of libraries, each incorporating one of the options described below. The option that you select determines how protected applications interact with the Run-time Environment (the RTE). The available options are:

> **Version-restricted option** (Recommended for best security and reliability in the protected application)

For protected applications that require the RTE: With the version-restricted option, the applications will require a *minimum version* of the RTE (the earliest version that contains the latest important security and reliability enhancements). Use of the version-restricted option ensures that end users cannot downgrade to an earlier version of the RTE and that they use a version of the RTE that provides the best quality together with all the latest security and reliability fixes. This restriction applies both for local deployment of the RTE and for deployment of the RTE on a remote license server machine.

For each new release of Sentinel LDK, the required *minimum version* number is updated only if the RTE for that release contains significant security and reliability enhancements.

Example: The required *minimum version* of the RTE for applications protected with versions 7.9 through 8.0 of the customized vendor libraries remains as RTE version **7.90**, because this version of the RTE contains the latest significant security and reliability enhancements. Later versions of the RTE contain less important enhancements and fixes.

NOTE The version-restricted option is only relevant for the static Licensing API because the user can replace the new version of the dynamic Licensing API with an older version.

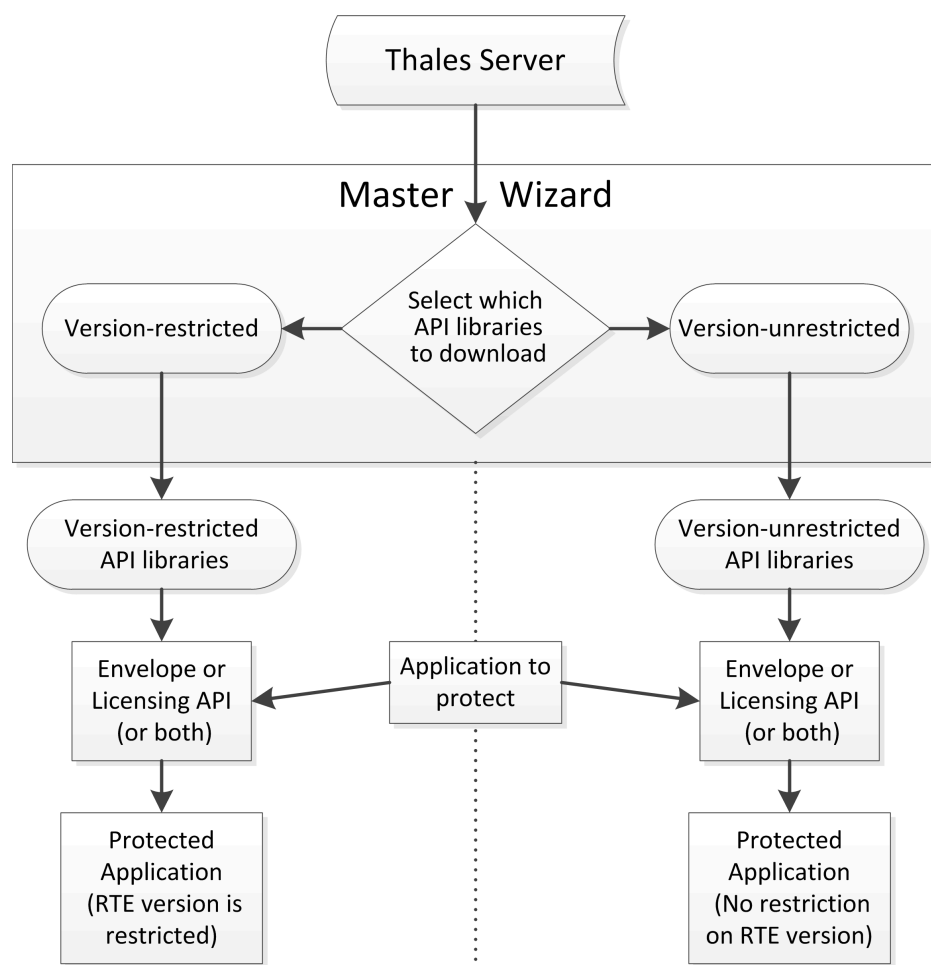
Example: Given that the dynamic Licensing API version 8.1 has a security issue. The vendor downloads the version-restricted dynamic Licensing API 8.2 using the Master Wizard, and then releases the new version of the dynamic Licensing API. However, a user can bypass any new security enhancements in the new version if they can obtain the old version of the dynamic Licensing API and replace the new version.

> **Version-unrestricted option** (For compatibility with all versions of the RTE)

For protected applications that require the Run-time Environment: The applications will not check the version number of the RTE. Applications protected with this option can be used with all versions of the RTE. Select this option only if you want to avoid upgrading the RTE at end user sites. This option simplifies deployment, especially when network license servers are used, but does not guarantee that security and reliability fixes in later RTE versions are employed.

NOTE With either option, users will need to upgrade their RTE if the protected application uses specific functionalities that require a later version of the RTE.

The diagram that follows illustrates how this process operates.



For more information, see “Required Version of the Run-time Environment” in the [Sentinel LDK Software Protection and Licensing Guide](#).

Using the Master Wizard to Introduce a Sentinel Vendor Key

Perform the procedure that follows to run the Sentinel LDK Master Wizard and introduce one of the Sentinel Vendor keys (Master Key or Developer Key).

NOTE You can use either a Developer key or a Master key with the relevant Batch Code to perform this process. There is no requirement to use a specific key. However:

- > To protect applications, a Developer key must usually be left connected to each machine where Sentinel LDK Envelope is used.

To introduce a Sentinel Vendor key:

1. **Prerequisite:** Choose the machine on which to run the Master Wizard and decide what you want to accomplish before starting this procedure. For details, see ["Master Wizard Functions" on page 16](#).
2. Connect a Vendor key to the relevant machine in one of the following ways:
 - Connect the key to the machine locally.
 - Connect the key to the machine using a remote USB solution as described in ["Remote Connection of Vendor Keys" on page 17](#).
3. From the Start menu, select: **Thales > Sentinel LDK**. The Sentinel LDK Launcher program selection screen is displayed.
4. From the Sentinel LDK Launcher screen, choose **Additional Tools > Sentinel Master Wizard**.

NOTE If you open either Sentinel LDK Envelope or Sentinel LDK ToolBox, and the application detects a Vendor key with a new Batch Code, the Master Wizard starts automatically.

The Log In to Sentinel EMS window is displayed:

5. In the user name and password fields:
 - Leave these fields blank.

6. If you are configuring Sentinel LDK-EMS (hosted by Thales or on a remote machine) or you want to generate customized RTE installers (as described in ["Master Wizard Functions" on page 16](#)):
- a. Click **Advanced**. Use these additional fields to specify public information for accessing Sentinel EMS from your customers' machines.

Log In to Sentinel EMS

Sentinel LDK Master Wizard

THALES

This login is to introduce your Sentinel LDK Master key to Sentinel EMS.
You must have EMS administrator privileges.

User Name:

Password:

Evaluation default password: admin

▼ Advanced

Server Address:

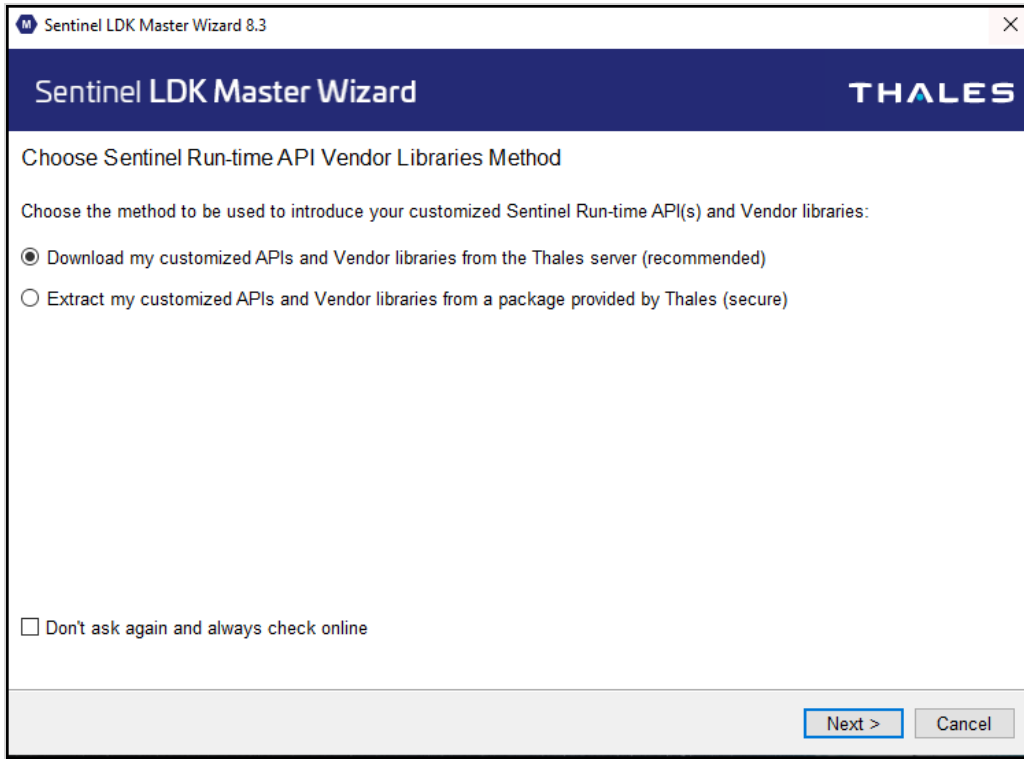
Port: ☒ Use SSL

Log In Cancel Skip Login

- b. In **Server Address**: Specify the URL for accessing Sentinel EMS
- c. In **Port**:
 - Enter **443**.
- d. In **Use SSL**:
 - Select the check box.

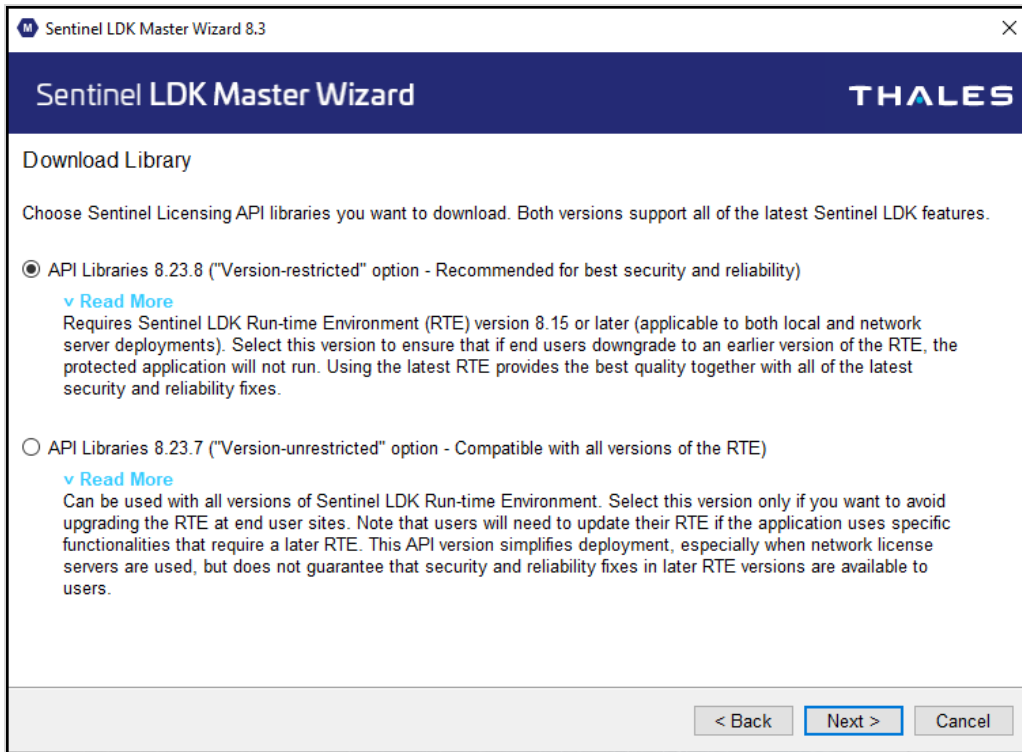
7. Click Skip login.

The following screen is displayed:

**8. Select the desired method for introducing your Vendor key.** For more information, see ["Methods of Introducing a Vendor Key" on page 16](#).

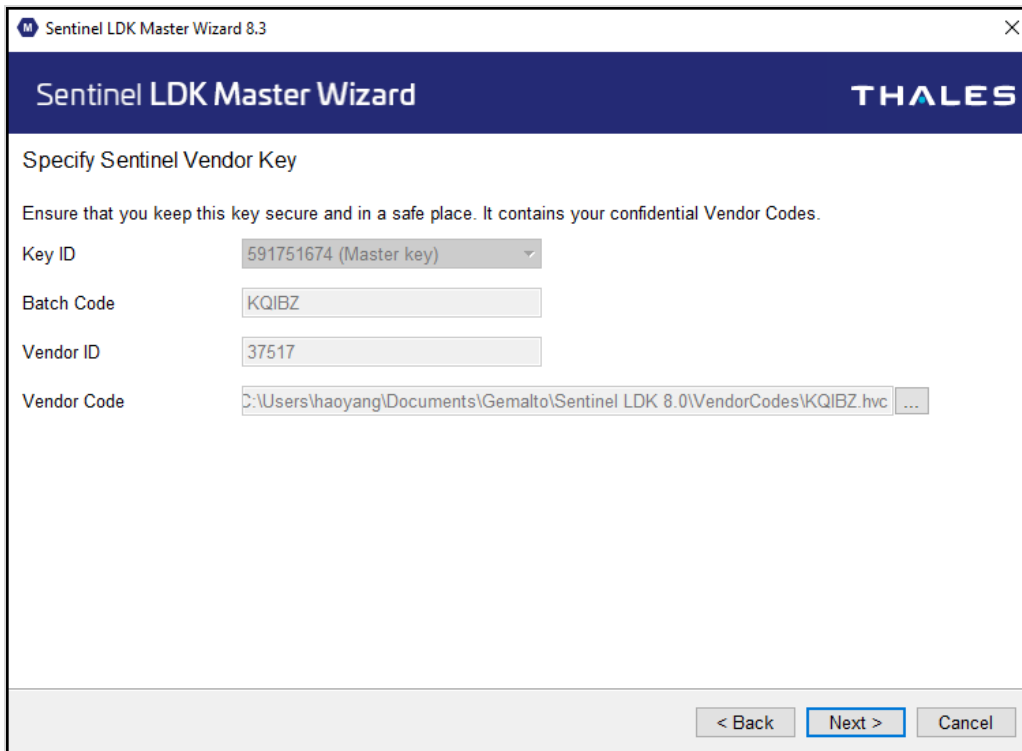
9. Click **Next**. (If you chose the "Extract" method above, the wizard asks you to browse to and select your MWP file.)

The following screen is displayed:



10. Select the **version-restricted** or **version-unrestricted** option (see "[Selecting the Version-Enforcement Option](#)" on page 17). Click **Next**.

The following screen is displayed:



Sentinel LDK Master Wizard **THALES**

Specify Sentinel Vendor Key

Ensure that you keep this key secure and in a safe place. It contains your confidential Vendor Codes.

Key ID: 591751674 (Master key) ▼

Batch Code: KQIBZ

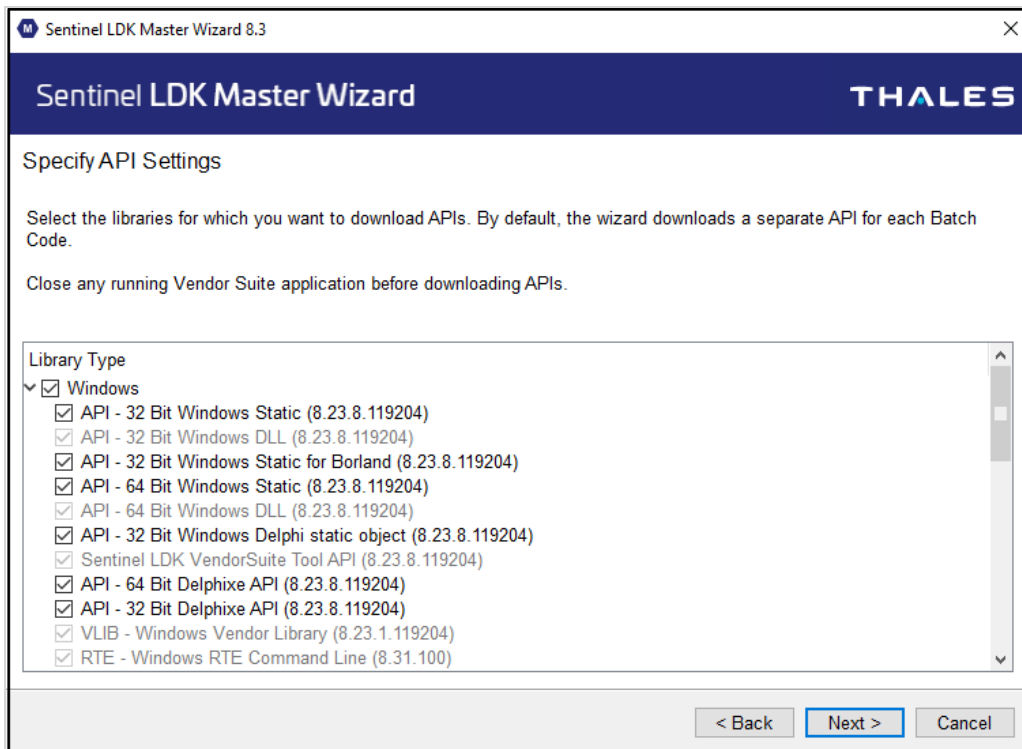
Vendor ID: 37517

Vendor Code: C:\Users\haoyang\Documents\Gemalto\Sentinel LDK 8.0\VendorCodes\KQIBZ.hvc ...

< Back Next > Cancel

11. Ensure that the Key ID for the relevant Vendor key is displayed. Click **Next**.

The following screen is displayed:



Sentinel LDK Master Wizard **THALES**

Specify API Settings

Select the libraries for which you want to download APIs. By default, the wizard downloads a separate API for each Batch Code.

Close any running Vendor Suite application before downloading APIs.

Library Type

- ☒ Windows
 - ☒ API - 32 Bit Windows Static (8.23.8.119204)
 - ☒ API - 32 Bit Windows DLL (8.23.8.119204)
 - ☒ API - 32 Bit Windows Static for Borland (8.23.8.119204)
 - ☒ API - 64 Bit Windows Static (8.23.8.119204)
 - ☒ API - 64 Bit Windows DLL (8.23.8.119204)
 - ☒ API - 32 Bit Windows Delphi static object (8.23.8.119204)
 - ☒ Sentinel LDK VendorSuite Tool API (8.23.8.119204)
 - ☒ API - 64 Bit Delphix API (8.23.8.119204)
 - ☒ API - 32 Bit Delphix API (8.23.8.119204)
 - ☒ VLIB - Windows Vendor Library (8.23.1.119204)
 - ☒ RTE - Windows RTE Command Line (8.31.100)

< Back Next > Cancel

- 12.** Select the libraries for which you want to generate APIs and select the Run-time Environment installers that you want to download and configure (some items are selected by default and cannot be cleared).

NOTE The Specify API Settings screen is always displayed and the selected items downloaded each time you run the Master Wizard. Ignore these items if you do not need them on the machine where you are running the wizard.

- 13.** Click **Next**.

- The generated APIs are downloaded to the following directory, under the appropriate subdirectory:
%userProfile%\Documents\Thales\Sentinel LDK 9.0\API\Licensing\
- The configured Run-time Environment installers are downloaded to:
%userProfile%\Documents\Thales\Sentinel LDK 9.0\Redistribute\Runtime\

- 14.** Click **Finish** to close the wizard.

For additional information on Vendor Codes, see "Understanding Sentinel LDK Software Protection and Licensing" in the [Sentinel LDK Software Protection and Licensing Guide](#).

CHAPTER 4: Configuring High Availability for Cloud Licensing

Sentinel LDK supports configuring a vendor-hosted cloud license server for high availability.

Sentinel LDK License Manager servers in the vendor's data center can be configured to store licenses in a common external trusted license storage (a MySQL database cluster).

NOTE Sentinel LDK License Manager servers are referred to as *license servers* in this document.

You can set up two or more active license servers. The load balancer spreads out the traffic of the workload among the license server machines. All of the License Managers handle license requests simultaneously.

This section describes how to configure Sentinel LDK to support high availability for cloud licensing hosted by the vendor.

NOTE

- > The purpose of this section is to demonstrate one method for implementing high availability, using NGINX. Using the functionality provided by Sentinel LDK, you can use the same tools and methods or you can use other tools and methods to accomplish the same goal.
- > If you are working with the active-passive configuration for multiple License Managers, see the High Availability Configuration Guide available from [here](#).

Overview

Vendor-hosted cloud licensing provides vendors with a simplified method of distributing and managing software licenses for their protected applications. However, this method also obligates the vendor to ensure that the Sentinel LDK License Manager server (referred to below as *license server*) for the hosted cloud licenses are available at all times.

To support high availability for license servers, multiple license servers are typically used. A load balancer distributes license requests among the license servers to ensure that all requests are processed without delay. In the event one of the license servers fails, the remaining license servers provide high availability without causing any downtime or loss of licenses. Some of solutions for redundant license servers use 2-out-of-3 licensing concept to limit license abuse.

Challenges with Redundant License Manager Schemes

Traditional on-premises redundant License Manager schemes face the following challenges:

- > License seat management

If the license is a network license, the failover system must be able to handle distribution of network seats between the primary and secondary License Manager dynamically, and the system must be able to prevent license abuse by unscrupulous customers.

- > License persistent data sync

If the license contains persistent data such as an execution counter, and the counter is exhausted in one License Manager, the failover system must be able to cope with this when switching to an alternate License Manager.

- > License activation/update

Traditionally, each License Manager must be capable of handling, activating and updating the licenses that it manages.

The License Manager provided by default by Sentinel LDK stores licenses in a "secure storage". This type of storage can be accessed and updated only by the specific License Manager that is used to create it. As a result, this type of License Manager is not suited for use with a failover system. It is not possible to synchronize license data among License Managers that use secure storage.

Trusted License Storage Solution

With Sentinel LDK 8.3 and later, a License Manager can be configured to support "trusted license storage". Licenses are stored in an external MySQL data base. This type of storage can be accessed and updated by multiple License Managers. As a result:

- > You can set up a MySQL database cluster to serve as a trusted license storage. MySQL allows you to back up and restore the database without clone protection issues. The database cluster can provide database backup and failover and ensure uninterrupted access to the license information.
- > You can set up multiple License Managers to support high availability. All the License Managers can use the same trusted license storage.

This solution poses none of the challenges described above for traditional on-premises redundant License Managers. Sentinel LDK License Managers can be configured to support active-passive (backup) or active-active high availability deployment.

This feature is available for subscription vendors. The trusted license storage (MySQL) is adapted to enable high availability.

Your License Managers are installed on multiple machines. This setup significantly reduces the possibility that a single point of failure will disrupt the availability of licenses to your customers.

Using a MySQL database for cloud license storage provides the following advantages:

- > The License Manager is much faster at startup as V2C files do not need to be preprocessed.

- > Only the database has state, removing the need for any kind of storage on the license server machines.
- > Performance on write operations is improved because the operations don't require the security features.

This document describes how you can configure your license servers to ensure high availability.

Migrating Licenses to the Trusted License Storage

When you configure a license server machine with existing licenses for high availability, the licenses are automatically migrated to the trusted license storage (MySQL database).

Migration only occurs if the MySQL database is empty when it is first connected to the License Manager.

The original licenses remain in the secure storage on the license server machine, but they are no longer accessed or maintained by the License Manager.

NOTE After moving from a local database (SQLite) to the trusted license storage (MySQL database), performance becomes dependent on the network performance and MySQL server performance.

Prerequisites

The following prerequisites must be satisfied in order to configure or use high availability for Sentinel LDK:

- > You must have the Cloud License module in your Sentinel LDK Master License.
- > The Pool of New SL Keys (Feature ID 3) and SL Pool of Seats (Feature ID 4) must be subscription-based or perpetual (and not metered).
- > The cloud license server machines must be Linux machines.
- > For the active-active configuration, the Run-time Environment on each cloud license server must be version 8.41 or later.

NOTE If your Master License does not satisfy the prerequisites listed above: You can still evaluate high availability for cloud licensing by using a MySQL database for cloud license storage with the DEMOMA Batch Code.

Machine Requirements

Machines requirement depend on actual workload (for example, the number of clients that you want to support).

If you are using Google Cloud Platform and Kubernetes, all the resources can be adjusted on demand.

Thales suggests an initial configuration as follows:

- > NGINX machine: 2 CPUs and 1 GB RAM
- > Each License Manager Service machine: 2 CPUs and 2 GB RAM
- > MySQL machine: 4 GB RAM

The solution described in this document is compatible with deployment using Kubernetes and with Google native load balancer.

Limitations

- > SL Legacy licenses are not supported on the MySQL database.
- > When high availability is implemented, clients' machines are not able to report the number of currently-available network seats. As a result:
 - In Admin Control Center, the Products page > **Available** column always reports the total number of network seats defined, ignoring the number of seats in use.
 - In Sentinel Licensing API, the **currentlogins** field in the **hasp_get_sessioninfo()** request always reports 0.

Requests to Sentinel Admin API (directed to the server) can be use to retrieve the effective numbers of seats in use.

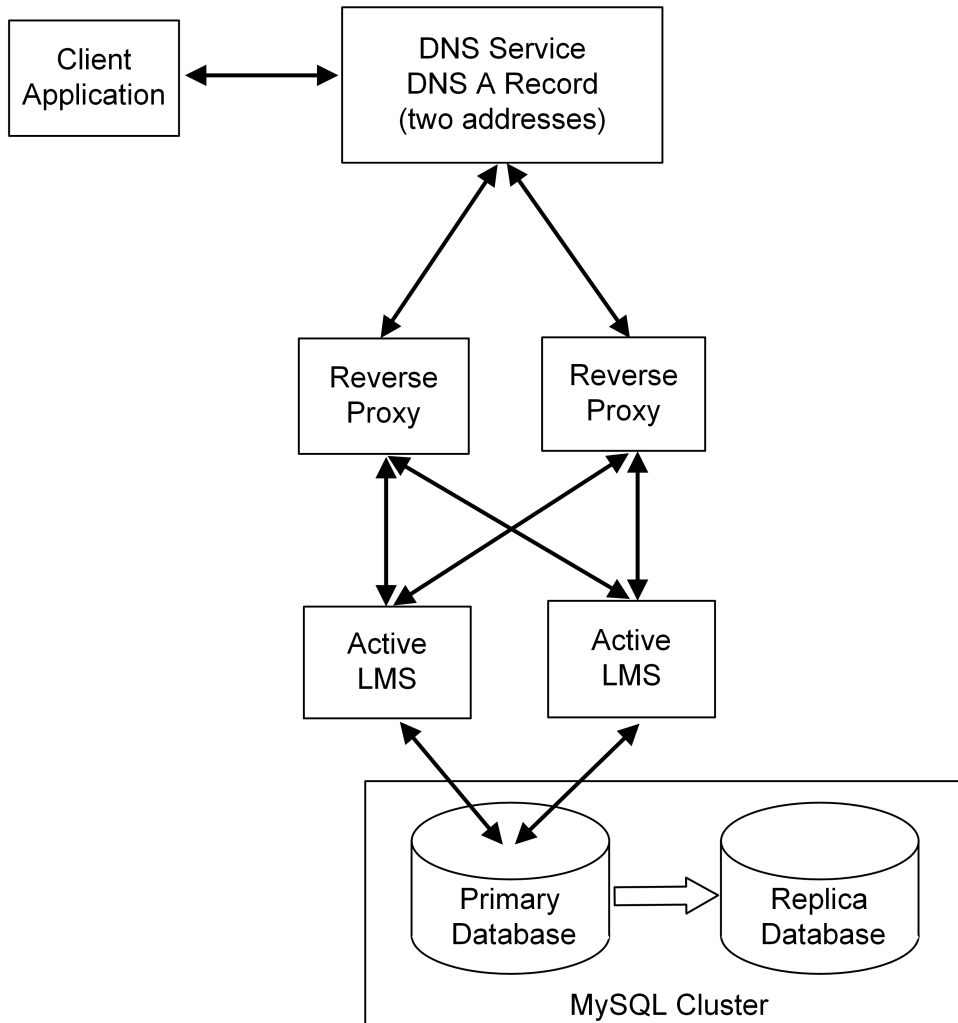
Detaching/Rehosting Licenses

When using cloud License Managers with MySQL trusted storage:

- > The following actions *are not* supported:
 - Rehosting from trusted storage to secure storage
 - Detaching licenses to trusted storage
- > The following actions *are* supported:
 - Rehosting from one trusted storage to another trusted storage
 - Rehosting from secure storage to trusted storage. (However, this does not result in a usable license unless the license is cloud-enabled.)
 - Detaching licenses from trusted storage to secure storage (client)

High-Level Architecture

The following diagram provides a high-level overview of the architecture for high availability for cloud licensing.



The elements in this diagram are described below.

Client Application

The client (protected) application integrates with the Sentinel LDK Licensing API. You can configure the Licensing API (or License Manager) INI file to set **serveraddr** with the DNS address.

The Licensing API (or License Manager) always attempts to contact all of the available License Managers in parallel, and it uses the one that responds.

The Licensing API for cloud licensing uses HTTP with a proprietary cryptographic algorithm. This protocol is similar to [TLS-PSK](#).

DNS Service

When two license manager services bring redundancy capability, the load balancer (NGINX) itself can still leave a single point of failure. High availability for the load balancer layer can be improved using one of the following options:

- > Using DNS with single floating IP address

Floating IP is a static public IPv4 address that can be attached to both reverse proxy instances. It directs traffic to one instance at the time and can be switched between multiple instances immediately. For this option, the DNS record only needs to contain one static IP address.

- > Using DNS with multiple IP addresses

You can create a DNS "A" record to store multiple IP addresses of reverse proxy instances.

Reverse Proxy

The reverse proxy should be configured as active-active mode. As a result, license requests will be redirected to one of License Managers based on the load balancing policy. For example, round-robin or least-connected load balancing can be used. If one of the License Managers is down, a "retry login" mechanism implementation is not required in the client application code for active-active deployment.

The reverse proxy can perform an active health check via the following License Manager health check end point: **/sentinel/ldk/v1/healthz**

When a load balancer is used, it should be configured to use the same License Manager service instance for a given client or session. For more information, see ["Requirements for the License Server Machines" on page 33](#).

Load Balancer Policy

Sentinel Licensing API is not a stateless API. When using this API, you must configure a sticky session policy in the load balancer or reverse proxy to ensure that a client request is redirected to a specific network server for the duration of a session.

In general, cloud licensing supports three sticky session policies:

- > IP hash – The IP address of the client is used to determine which server receives the request.
- > Consistent hash – The client generates a unique ID. Sentinel LicensingAPI has a special HTTP header (**X-LDK-Instance**).
- > Session cookies – The load balancer assigns a unique cookie ID back to client, and the next request from the client carries this cookie back to the load balancer.

License Manager Service (LMS)

The high-availability solution is only valid for an LMS based on trusted license storage. To enable this type of storage, you must first set environment variables or use the License Manager INI file to enable the License Managers to connect to the MySQL database. Next, you use Sentinel LDK-EMS to generate an authorization

file, and apply the file to one of the License Manager instance. This enables the License Managers to use the MySQL database as a trusted license storage.

The ["Implementation" below](#) section demonstrates how to set up active-active license servers using Docker Compose and NGINX to handle License Manager failover.

MySQL Cluster

Machine on which a MySQL database or database cluster for license storage resides. The vendor has complete control over this database and is responsible for the security of the database. This machine serves as the trusted license storage unit.

Note that with trusted license storage, the database is readable and accessible by the vendor, but the internal blobs in the database are still encrypted with the Vlib secrets.

Summary of Differences Between Active-Active and Active-Passive Configuration

The table that follows summarizes considerations when you are changing from the active-passive configuration to the active-active configuration.

	Active-Passive	Active-Active
Client Application	Retry must be implemented.	Retry is not required.
DNS	Use a DNS with a single floating IP address. <i>Or</i> Configure your DNS record as failover type (active-passive) to return only one healthy IP address at a time to avoid potential license abuse.	Configure the DNS record as active-active type with two IP addresses of reverse proxy.
Reverse Proxy	Reverse proxy should be configured for active-passive mode.	Reverse proxy should be configured for active-active mode.
License Manager Service	Run-time Environment on each cloud license server must be version 8.31 or later.	Run-time Environment on each cloud license server must be version 8.41 or later.
MySQL Cluster	There is no difference between active-active and active-passive configuration.	

Implementation

This section describes the procedure required to set up high-availability license server machines.

(A license server is a machine on which Sentinel LDK License Manager service is installed.)

Note the following:

- > Each machine referred to in this section can be a physical machine or virtual machine.
- > The Batch Codes referred to in this section are the Batch Code that you are using for cloud licensing.

(["Deploying a CL Server in Kubernetes on GCP" on page 42](#) describes how to deploy a cloud license server machine in Kubernetes on Google Cloud Platform.)

Requirements for the License Server Machines

The following are the requirements for Sentinel LDK License Manager when configured for high availability:

- > When a load balancer is used, it should be configured to use the same License Manager service (*LMS*) instance for a given client or session. When the LMS instance used changes within a login session, the client API requires additional communications to re-establish new secure channels with the new LMS instance. This occurs transparently, but it requires a certain amount of time, and it should be avoided for optimal performance.
- > The machine time of all the license server machines in the cluster must be synchronized. If the time on one of the license server machines is ahead of the others, the LMS on that machine will kill all the other LMS sessions.
- > The initial start of the first LMS in the cluster must have creation rights on the MySQL database. Creation right are required to create new tables.
- > For the active-active configuration, you must enable a sticky session load balancing policy.
- > The VLIB version must be in sync with the LMS version. Older VLIBs are not supported. If the versions do not match, no license is loaded and an appropriate error is logged.

For a list of supported VLIB versions and the matching LMS versions, see the [Sentinel LDK Release Notes](#).

NOTE

- > Sentinel Licensing API returns the error `HASP_CLOUD_STORAGE_BUSY` when conflicting requests cannot be handled in a timely manner. This error is not expected to occur unless an unexpected deadlock condition in the database is reached or the license server machine is in starvation. The client can detect this special condition by checking for this error.
- > In Admin Control Center 8.41 and later, the access to remote LMs is always disabled. The configuration panel **Access to Remote License Managers** is not present.

Setting Up the License Server Machines

To set up high-availability license server machines:

1. Configure the DNS Service and Reverse Proxy in your data center to satisfy the requirements described in ["High-Level Architecture" on page 30](#).
2. Install MySQL on a machine that will serve as the database server for trusted license storage.

It is not necessary to create a license storage database on the server. The license storage database will be created automatically as described later in this procedure.

NOTE

- > You will have complete control over this database and are responsible for the security of the database.
- > If necessary, you can reduce the load on the MySQL database by relaxing ACID compliance. For details, see ["Configuring MySQL for Relaxed Durability" on page 45](#).

3. Set up the license server machines.

Set up the two license server machines to serve as the active license servers using either of the methods described below.

NOTE You can use an existing license server machine for one of the machines. Any licenses already present on the license server machine will be automatically migrated to the trusted license storage in the MySQL database. For details, see ["Migrating Licenses to the Trusted License Storage" on page 28](#).

- Using a generated RTE installer
 - i. Obtain the Run-time Environment Installer that is generated by the Master Wizard when you introduce your Vendor keys. For more information, see ["Introducing Your Sentinel Vendor Keys to Sentinel LDK" on page 15](#).
 - ii. install the Sentinel LDK Run-time Environment (RTE) on the two machines that will serve as the active license server machines.

If you are using multiple Batch Codes, copy the Vlibs for any additional Batch Codes to the `/var/hasplm` directory on each machine.

- Using a Docker image

A Docker image that contains an installed Sentinel LDK Run-time Environment is available.

- i. Download the Docker image from <https://hub.docker.com/u/thalesgroupsm>.

(The Dockerfile used to build this Docker image can be viewed in ["Dockerfile Listing" on page 41](#).)

- ii. Import the downloaded Docker image on the two machines that will serve as the active license server machines. Use the following command on each machine:

docker image import sentinel-ldk-rte.tar imagename:version

- iii. Copy your Vendor libraries for all Batch Codes to the **/var/hasplm** directory on each license server machine.

4. Configure each license server machine.

On each license server machine, configure the options described below.

You can specify options:

- As entries in the **hasplm.ini** file. (Recommended method)
- Defined as environment variables on the machine. (Use this option when working with Docker.)
- In the **mysql.cnf** configuration file.

In the **mysql.cnf** configuration file, the **[sentinel_ldk]** section is read. The **[client]** section is also read, as with any generic MySQL client application. (Specify the location of the **mysql.cnf** file in the **hasplm.ini** file.) For typical high availability configuration, the use of a CNF file is not required, as the other options that available for the **hasplm.ini** file are typically enough.

NOTE When you perform the initial startup of the LMS on the two license server machines (later in this procedure), the configuration parameters that you specified in the **hasplm.ini** file are copied to the MySQL database. Once this occurs, the configuration parameters in the MySQL database take precedence over parameter values in the **hasplm.ini** file. Any changes that you make to the configuration parameters using the Admin API or Admin Control Center are written directly to the database; no changes are written to the **hasplm.ini** file.

The table below describes the available configuration options as **hasplm.ini** entries and as environment variables.

Note that the four environment variables **database_mysql_host**, **...user**, **...password**, **...port** and the environment variable **database_mysql_cnf** are alternative ways to configure the same MySQL options. The variable **database_mysql_cnf** is more powerful as it allows you to configure additional options, such as SSL support.

File Entry or Environment Variable	Notes
database HASPLM_DATABASE	Specify the value: mysql (This entry is required even if using the MySQL CNF file.)
database_mysql_host HASPLM_DATABASE_MYSQL_HOST	The host machine where MySQL is located.

File Entry or Environment Variable	Notes
database_mysql_user HASPLM_DATABASE_MYSQL_USER	User name for the MySQL account to use to connect to the database.
database_mysql_password HASPLM_DATABASE_MYSQL_PASSWORD	Password for the above MySQL account.
database_mysql_port HASPLM_DATABASE_MYSQL_PORT	Port on the database server for connecting to the database. Default: 3306
database_mysql_database HASPLM_DATABASE_MYSQL_DATABASE	<p>Name of the MySQL database to create. Default is sentinel_ldk.</p> <p>This is similar to the database option in my.cnf. However, when this option specified in the hasplm.ini file, the database is created automatically if it does not yet exist. The same option in my.cnf causes the connection to fail if the specified database does not exist.</p>
database_mysql_library	<p>Path of the MySQL client library.</p> <p>Default for Linux is: libmariadb.so.3</p> <p>In Linux: Install the libmariadb.so.3 using the distribution package manager.</p>
database_mysql_cnf HASPLM_DATABASE_MYSQL_CNF only needed for mysql file.	<p>Path of the MySQL configuration file.</p> <p>The default is my.cnf in the standard MySQL search directories. In this file the [sentinel_ldk] section is read. The [client] section is also read, as in any generic MySQL client application.</p> <p>This entry is only required if you are using the MySQL configuration file to configure high availability. Note that the use of the MySQL configuration file is not strictly required for normal use, as the options in the License Manager INI file are typically enough to handle the required configuration.</p>

File Entry or Environment Variable	Notes
cloud_portal HASP_CLOUD_PORTAL	<p>Whether Sentinel Admin Control Center should display a message that Sentinel LDK Cloud Portal is being used to manage client identities for this LMS. If yes, assign the value 1 to this variable; otherwise, assign the value 0 or do not define this variable.</p> <p>Notes:</p> <ul style="list-style-type: none"> > The message is only displayed after Sentinel LDK Cloud Portal has been used at least once to create client identities. > Setting the value to 1 for this variable does not block Sentinel Admin Control Center from being used to manage client identities. However, Thales recommends that you not use Sentinel Admin Control Center to manage client identities once Sentinel LDK Cloud Portal has been implemented.
rate_token_max	<p>Maximum number of tokens in the bucket for rate limiting. This is also the starting value for the number of tokens in the bucket. Default: 0</p> <p>If rate_token_max or rate_token_period_ms is 0, rate limiting is disabled.</p>
rate_token_period_ms	<p>Interval (in milliseconds) at which a new token is added to the bucket for rate limiting. For example, a value of 1000 means that a new token is added every second. Default: 0</p>

A typical **hasplm.ini** file would contain the following:

```
database = mysql
database_mysql_host = 192.168.1.235
database_mysql_user = root
database_mysql_password = Password1!
database_mysql_port = 3306
```

A typical **my.cnf** file would contain the following:

```
[mysqld]
port = 3306

[sentinel_ldk]
port = 3306
```

```
password = Password1!
user = root
server = 192.168.1.235
```

5. Start the LMS on both license server machines.

NOTE At this point, if one of the license server machines contains existing licenses, the licenses are migrated to the trusted license storage in the MySQL database. For details, see ["Migrating Licenses to the Trusted License Storage" on page 28](#).

6. Generate fingerprint files.

On one of the active license server machines, use Admin Control Center to generate a fingerprint file (for each Batch Code) for the machine:

- a. Start Admin Control Center on the machine.
- b. In the navigation pane, click **Sentinel Keys**.
- c. On the Sentinel Keys page, identify the entry at the top of the list for the relevant Batch Code. The **Location** column contains **Local**.
- d. Click the **Fingerprint** button in the entry. The **fingerprint_batchCode.C2V** file is generated.

7. Create trusted storage authorization files.

For each Batch Code, use the relevant fingerprint file generated above to generate a trusted storage authorization V2C file using Sentinel EMS. For details, see [Sentinel EMS User Guide](#).

8. Apply the trusted storage authorization files.

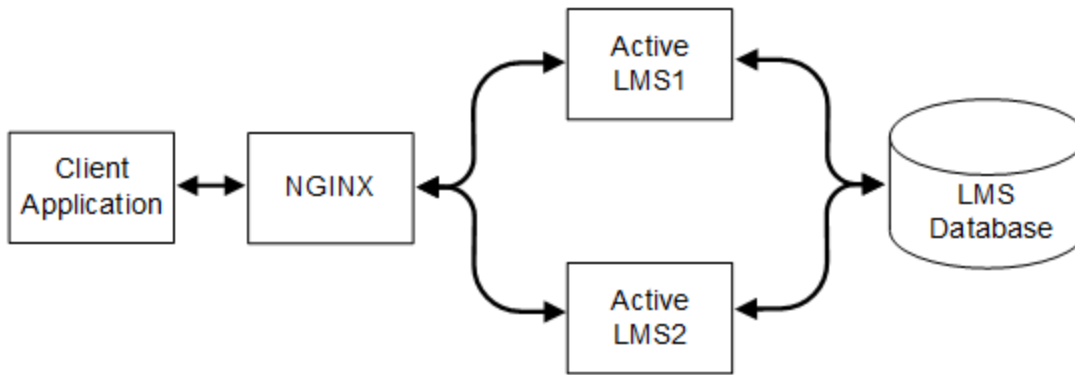
Using Admin Control Center on the active license server machine, apply the trusted storage authorization V2C file for each Batch Code:

- a. Select **Update/Attach** from the navigation pane in Admin Control Center.
- b. Click **Select File** and apply the relevant V2C files.

9. Configure the web server.

This step demonstrates how you can use Docker Compose and NGINX to set up the active license server machines.

This demonstration uses two LMS instances (**lms1** and **lms2**) as active license server machines.



Configure NGINX and Docker Compose as follows:

- The content of **nginx.conf** should be similar to the following:

```

user  nginx;

events {
    worker_connections  1000;
}

http {
    upstream server_lms {
        ip_hash;          #load balancing policy
        #By default, it is active-active setup.
        server lms1:1947;
        server lms2:1947;
        #commented part is for active-passive setup.
        #server lms1:1947 weight=1 max_fails=3 fail_timeout=10s;
        #server lms2:1947 weight=1 max_fails=3 fail_timeout=10s backup;
    }

    server {
        listen 80;          #Runtime API will go through http.
        listen 443 ssl;     #ACC can be accessed by https
        ssl_certificate      /etc/nginx/certs/nginx-selfsigned.crt;
        ssl_certificate_key  /etc/nginx/certs/nginx-selfsigned.key;

        location / {
            proxy_pass http://server_lms;
            proxy_set_header    Host      $host;
            proxy_set_header    X-Real-IP  $remote_addr;
            proxy_set_header    X-Forwarded-For $proxy_add_x_forwarded_for;
        }
    }
}

```

- The content of **docker-compose.yml** should be similar to the following:

```

version: "3"

services:
  lms_database:
    image: mysql:5.7

```

```

container_name: lms_database
volumes:
  - lms_db_data:/var/lib/mysql
restart: always
environment:
  MYSQL_ROOT_PASSWORD: root!
  MYSQL_DATABASE: lms
  MYSQL_USER: lms
  MYSQL_PASSWORD: Password1!

lms1:
  depends_on:
    - lms_database
  build: .
  container_name: lms1
  restart: always
  #hostname: lms1
  environment:
    HASPLM_DATABASE: mysql
    HASPLM_DATABASE_MYSQL_HOST: lms_database
    HASPLM_DATABASE_MYSQL_USER: root
    HASPLM_DATABASE_MYSQL_PASSWORD: root!
    HASPLM_DATABASE_MYSQL_PORT: 3306
  volumes:
    - ./haspvlib_x86_64_37517.so:/var/hasplm/haspvlib_x86_64_37517.so
    - ./hasplm.ini:/etc/hasplm/hasplm.ini
  depends_on:
    - lms_database

lms2:
  depends_on:
    - lms_database
  build: .
  container_name: lms2
  #restart: always
  #hostname: lms2
  environment:
    HASPLM_DATABASE: mysql
    HASPLM_DATABASE_MYSQL_HOST: lms_database
    HASPLM_DATABASE_MYSQL_USER: root
    HASPLM_DATABASE_MYSQL_PASSWORD: root!
    HASPLM_DATABASE_MYSQL_PORT: 3306
  volumes:
    - ./haspvlib_x86_64_37517.so:/var/hasplm/haspvlib_x86_64_37517.so
    - ./hasplm.ini:/etc/hasplm/hasplm.ini
  depends_on:
    - lms_database

nginx:
  image: nginx:latest
  volumes:
    - ./nginx.conf:/etc/nginx/nginx.conf:ro
    - ./nginx-selfsigned.crt:/etc/nginx/certs/nginx-selfsigned.crt:ro
    - ./nginx-selfsigned.key:/etc/nginx/certs/nginx-selfsigned.key:ro

  depends_on:
    - lms1

```



```

- lms2
ports:
- "80:80"
- "443:443"

```

10. Confirm the setup as follows:

- a. Run **docker-compose up**.
- b. Open Admin Control Center of the LMS exposed by NGINX and determine the computer name on the Diagnostics page. The computer name should be the name of the active license server machine.
- c. Run **docker-compose kill lms1** to stop the **lms1** service.
After 10 seconds, NGINX will transfer all the requests to **lms2**.
- d. Check the computer name again. The name should have changed from **lms1** to **lms2**.

Dockerfile Listing

The Dockerfile listed below was used to build the Docker image described earlier in this guide.

```

#base image
FROM ubuntu:20.04

MAINTAINER LDK-Team "ldk-team@thalesgroup.com"

#working directory
WORKDIR /lms

#expose ports
EXPOSE 1947
EXPOSE 80

COPY aksusbd_8.52-1_amd64.deb /lms

RUN apt-get update && \
#libmariadb.so.3 serves as database client library and is required for LM
# to connect to MySQL
    apt-get install -y libmariadb3 && \
    dpkg -x aksusbd_8.52-1_amd64.deb / && \
    groupadd lms_group && \
    useradd -g lms_group lms_user && \
    chown -R lms_user:lms_group /var/hasplm && \
    chown -R lms_user:lms_group /etc/hasplm && \
    chmod +x /usr/sbin/hasplmd_x86_64

#user with less privilege
USER lms_user

#option "-f" makes the service a foreground process instead of a
# background process
ENTRYPOINT ["/usr/sbin/hasplmd_x86_64", "-f"]

```

Deploying a CL Server in Kubernetes on GCP

This topic describes how to deploy a cloud License Manager service in a Docker container using a MySQL database to Kubernetes on GCP (Google Cloud Platform).

Prerequisites

The following is required for deploying a cloud license server on GCP:

- > A console that is able to access Google Cloud Platform
- > Cloud database instance for MySQL 5.7, with a user account created for Sentinel LDK License Manager service. (MySQL Docker can also be used for this purpose)

Database Initialization for the LMS (Sentinel LDK License Manager Service)

- > If the database user has full access to the database, the database and tables can be created automatically by the LMS.
- > If the database user only has the read/write rights to update the data in tables, but no rights to create the database and tables, the deployment user should create the database and tables for the LMS manually. Use the file **sentinel_ldk_table.sql** to perform initialization.

Deployment

NOTE The procedure that follows describes how to implement an LMS in Docker on GCP. If you want to expose the LMS directly on the cloud platform, consider the security enhancements required to protect the service deployed on Kubernetes according to your security requirements.

To deploy the License Manager Service in a Docker container on Kubernetes:

1. Enter the following to create a VLIB configmap on Kubernetes with a vendor library:
kubectrl create configmap haspvlib --from-file=./haspvlib_x86_64_37517.so

The vendor library should be located in the path */var/hasplm* in Docker.

2. Enter the following to create the LMS initialization configmap:

kubectrl create configmap hasplmini --from-file=./hasplm.ini

The **hasplm.ini** file should be located in the path */etc/hasplm* in Docker.

NOTE The trusted IP address should be set to **0.0.0.0/0** in **hasplm.ini**. This enables the LMS to be accessed by the Load Balancer.

LMS Docker reads the following **configmap** file at startup. Once any LMS configuration is updated, all configuration information is saved to the MySQL database. Once that occurs, the configuration information in database is used instead of the information in the **configmap** file.

```
[SERVER]
listen_also = 1
requestlog = 1
loglocal = 1
logremote = 1
logadmin = 1
errorlog = 1
rotatelog = 1
pidfile = 1
passacc = 1
accessfromremote = anyone

accremote = 1
adminremote = 1

[REMOTE]
broadcastsearch = 0

[EMS]
emsurl = http://localhost:8080
emsurl = http://127.0.0.1:8080

[TRUST]
trusted_ip = 0.0.0.0/0
```

3. Create the LMS deployment **yaml** file. The **yaml** file shows:

- How to deploy the LMS Docker image.
- How to implement the LivenessProbe and ReadinessProbe for the LMS.
- How to load the **hasplm.ini** and vendor library with **configmap** on Kubernetes.

NOTE The replicas should be set to 1 when deploying LMS Docker on Kubernetes.

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: lms
  labels:
    name: lms
spec:
  replicas: 1
  selector:
    matchLabels:
      app: lms
  template:
    metadata:
      labels:
        app: lms
    spec:
```

```

containers:
- name: lms
  image: thalesgroupsm/sentinel_ldk_rte
  #should be set to "Always" when deploying with Kubernetes
  imagePullPolicy: IfNotPresent
  livenessProbe:
    httpGet:
      path: /sentinel/ldk/v1/healthz
      port: 1947
    initialDelaySeconds: 120
    timeoutSeconds: 30
    periodSeconds: 10
    successThreshold: 1
    failureThreshold: 3
  readinessProbe:
    httpGet:
      path: /sentinel/ldk/v1/readyz
      port: 1947
    initialDelaySeconds: 120
    timeoutSeconds: 30
    periodSeconds: 10
    successThreshold: 1
    failureThreshold: 3
  ports:
    - containerPort: 1947
  volumeMounts:
    - name: hasplmcfgfile
      mountPath: /etc/hasplm/hasplm.ini
      subPath: hasplm.ini
    - name: haspvlibfile
      mountPath: /var/hasplm/haspvlib_x86_64_37517.so
      subPath: haspvlib_x86_64_37517.so
  env:
    - name: HASPLM_DATABASE
      value: mysql
    - name: HASPLM_DATABASE_MYSQL_HOST
      value: mysql
    - name: HASPLM_DATABASE_MYSQL_PASSWORD
      value: root!
    - name: HASPLM_DATABASE_MYSQL_USER
      value: root
    - name: HASPLM_DATABASE_MYSQL_PORT
      value: "3306"
  volumes:
    - name: hasplmcfgfile
      configMap:
        name: hasplmini
    - name: haspvlibfile
      configMap:
        name: haspvlib

```

4. Create the LMS **yaml** file. It is up to you to decide how to expose the LMS to the public IP address. The **yaml** file below shows how to expose the LMS in the load balancer.

```

apiVersion: v1
kind: Service
metadata:
  name: lms
  labels:
    app: lms
spec:
  type: LoadBalancer
  ports:
    - port: 1947
      targetPort: 1947
      protocol: TCP
  selector:
    app: lms

```

5. Run the following to deploy the LMS:

```
kubectl apply -f lms_deployment.yaml -f lms_svc.yaml
```

The LMS can be accessed with the following URL:

http://<IP_exposed_by_the_LoadBalancer>:1947

Configuring MySQL for Relaxed Durability

This section describes how to configure MySQL to improve its performance and thus, the License Manager performance. This configuration is optional, but may be useful if performance becomes an issue.

The default MySQL configuration is ACID-compliant - that is, it satisfies the requirements for Atomicity, Consistency, Isolation and Durability. To ensure the durability requirement, MySQL enforces a sync to disk after each SQL transaction.

With a high server load, this requirement has a strong impact on performance. You can consider configuring MySQL to relax the durability requirement, to have only one sync to disk per second. The consequence of relaxing the durability requirement is as follows:

- > Negative impact: In the event the MySQL server fails, the database may lose transactions that occurred during the last second. For example, a license detach may be not recorded, and the user may get a free detach.
- > Positive impact: Transactions that require a write to the database may complete up to 10 times faster.

To test the relaxed durability configuration at runtime:

- > Run the following SQL snippet:

```

SET GLOBAL innodb_flush_log_at_trx_commit=0;
SET GLOBAL sync_binlog=0;

```

To restore the default configuration:**> Run:**

```
SET GLOBAL innodb_flush_log_at_trx_commit=1;  
SET GLOBAL sync_binlog=1;
```

To make the relaxed durability configuration permanent:**1. Add the following to `/etc/mysql/mysql.cnf`:**

```
[mysqld]  
innodb_flush_log_at_trx_commit=0  
sync_binlog=0
```

2. Restart MySQL with:

```
sudo systemctl restart mysql
```

CHAPTER 5: Installing Sentinel LDK Run-time Environment

This section describes how to install Sentinel LDK Run-time Environment on the following platforms.

- > ["Installing Sentinel LDK Run-time Environment for Mac" below](#)
- > ["Installing Sentinel LDK Run-time Environment for Linux" on page 51](#)
- > ["Installing Sentinel LDK Run-time Environment for Windows" on page 56](#)

Installing Sentinel LDK Run-time Environment for Mac

This section describes how to install the Sentinel LDK Run-time Environment on a machine with a Mac operating system, and explains how to modify the behavior of the daemons.

For information on supported platforms for Sentinel LDK Run-time Environment, see the [Sentinel LDK Release Notes](#).

In this section:

- > ["Installing Sentinel LDK Run-time Environment" below](#)
- > ["Installed Files" on the next page](#)
- > ["Modifying the Behavior of the Daemons" on the next page](#)

Installing Sentinel LDK Run-time Environment

Follow the instructions below to install the Sentinel LDK Run-time Environment on a machine with a Mac operating system.

To install the Sentinel LDK Run-time Environment:

1. Go to the Sentinel LDK *MacOS* directory on your Mac machine. For more information see the [Sentinel LDK Getting Started Guide for Mac](#).
2. Open `/MacOS/Redistribute`, and double-click `Sentinel_Runtime.dmg`.
3. Double-click the *Install Sentinel Runtime Environment* disk image icon. The installer wizard is launched.
4. Follow the instructions of the installer wizard until the installation is complete.

Following successful installation, the Sentinel LDK Run-time Environment is automatically launched. The first time that you run Admin Control Center and submit configuration changes, **hasplmd** creates configuration files in */private/etc/hasplm/*.

Installed Files

After you run the installation, verify that the following files have been installed on your hard drive:

- > */usr/local/sentinel/aksusbd* (support for Sentinel HL (HASP configuration) keys and HASP HL keys)
- > */usr/local/sentinel/hasplmd* (Sentinel License Manager daemon)
- > */Library/LaunchDaemons/com.aladdin.aksusbd.plist*
- > */Library/LaunchDaemons/com.aladdin.hasplmd.plist*

Modifying the Behavior of the Daemons

Behavior of the daemons can be modified by changing the switches used to start the daemons. Modification requires the following steps:

- > Terminating the daemons
- > Determining the switches to use
- > Saving the modifications
- > Restarting the daemons

To terminate the daemons:

1. Ensure that you have Administrator privileges.
2. Launch */Applications/Utilities/Terminal*.
3. Change the directory to: */Library/LaunchDaemons/*
4. At the command prompt, enter the following commands:

```
sudo launchctl unload com.aladdin.hasplmd.plist
```

```
sudo launchctl unload com.aladdin.aksusbd.plist
```

(When prompted, enter your administrator password.)

The daemons stop running.

To determine which switches to use:

Use the table that follows to determine which command line switches to use to set the behavior of the **aksusbd** and **hasplmd** daemons.

Daemon	Command	Description
Both	-f	Forces the daemon to work in the foreground. Required for launchd startup.
Both	-h, --help	Displays a list of available commands
Both	-l <level>	Specifies the level of log messages. The values are: 0 - Errors only 1 - Normal 2 - Verbose 3 - Ultra verbose
Both	v	Displays aksusbd and API versions OR Displays hasplmd version
aksusbd	-d <milliseconds>	Specifies the delay after connecting a Sentinel HL (HASP configuration) key or HASP HL key, before it can be accessed the first time (range 0–2000)
aksusbd	-q <entries>	Specifies the length of the work queue (default 64)
aksusbd	-u <mask>	Specifies the permission bits for the special socket file. Default is 666 (access for all users)
aksusbd	-s <file>	Specifies the communication socket name
hasplmd	-s, -start	Starts the Sentinel License Manager daemon
hasplmd	-u <user>	Launches daemon with owner as user to enhance security

To save the selected switches:

After determining which switches you want to employ, do the following to save the switches in the **.plist** files so that they will be used each time the daemons are launched when the system is restarted:

- > Either edit the relevant **.plist** files using a text editor OR use the /Developer/Applications/Utilities/Property List Editor (part of the Xcode Developer Tools) to do the following:
 - a. Add the modifications for **aksusbd** to */Library/LaunchDaemons/com.aladdin.aksusbd.plist*.
 - b. Add the modifications for **hasplmd** to */Library/LaunchDaemons/com.aladdin.hasplmd.plist*.

Ensure that the **-f** switch is included in both daemons.

To restart the daemons:

After saving the selected switches, do the following to restart the daemons:

1. Ensure that you have Administrator privileges.
2. Launch */Applications/Utilities/Terminal*.
3. Change the directory to: */Library/LaunchDaemons/*
4. At the command prompt, enter the following commands

```
sudo launchctl load com.aladdin.aksusbd.plist
```

```
sudo launchctl load com.aladdin.hasplmd.plist
```

(Enter your Administrator password when prompted.)

The daemons are restarted.

NOTE The Run-time Environment daemons are launched automatically when the system is restarted.

Installing Sentinel LDK Run-time Environment for Linux

This section describes how to install Sentinel LDK Run-time Environment v.9.12.1 on a computer with a Linux operating system.

For information on supported platforms for Sentinel LDK Run-time Environment, see the [Sentinel LDK Release Notes](#).

In this section:

- > ["Installing Sentinel LDK Run-time Environment" below](#)
- > ["Installed Files" on page 54](#)
- > ["Uninstalling Sentinel LDK Run-time Environment" on page 54](#)
- > ["Upgrading HASP HL Key Firmware" on page 55](#)

Installing Sentinel LDK Run-time Environment

NOTE When installing Sentinel LDK Run-time Environment on an end user's machine: To support your application on both 32-bit and 64-bit architectures, ensure that you provide both 32-bit and 64-bit customized Vendor libraries with the Run-time Environment installer. These libraries are contained in the following files:

- > `haspvlib_<vendorID>.so`
- > `haspvlib_x86_64_<vendorID>.so`
- > `haspvlib_armhf_<vendorID>.so`
- > `haspvlib_arm64_<vendorID>.so`

To install the Sentinel LDK Run-time Environment using RPM or DEB:

1. Go to the Sentinel LDK *Linux* directory on your Linux machine. For more information, see the [Sentinel LDK Getting Started Guide for Linux](#).
2. Disconnect your Sentinel HL key (if any) from the machine.
3. Open a terminal window and navigate to *Linux/Redistribute/Runtime*.
4. As root, enter the following command:
 - For RedHat, SUSE, or CentOS 32-bit ARM systems:

```
rpm -i aksusbd-9.12-1.armv7hl.rpm
```

- For RedHat, SUSE, or CentOS 64-bit ARM systems:

```
rpm -i aksusbd-9.12-1.aarch64.rpm
```

- For RedHat, SUSE, or CentOS 64-bit Intel systems:

```
rpm -i aksusbd-9.12-1.x86_64.rpm
```

- For Ubuntu or Debian 32-bit ARM systems:

```
dpkg -i aksusbd_9.12-1_armhf.deb
```

- For Ubuntu or Debian 64-bit ARM systems:

```
dpkg -i aksusbd_9.12-1_arm64.deb
```

- For Ubuntu or Debian 64-bit Intel systems:

```
dpkg -i aksusbd_9.12-1_amd64.deb
```

NOTE All install/uninstall commands must be executed with **root** rights. In Ubuntu, prefix the commands with the **sudo** command; in other distributions, use the **su** utility to become root in the terminal window.

The Sentinel LDK Run-time Environment is launched.

5. Reconnect the Sentinel HL key.

NOTE At this point, for older HASP HL keys, the firmware on the HL key may be automatically upgraded. During the upgrade process, the key will blink continuously. *Do not remove the key while it is blinking.* If you remove the key too soon, the key may no longer be visible in Admin Control Center. If the key is not visible, or if the upgrade does not occur, see ["Upgrading HASP HL Key Firmware" on page 55](#).

To install the Sentinel LDK Run-time Environment from a script:

(Use this procedure if the distribution does not support RPM or DEB.)

1. Go to the Sentinel LDK *Linux* directory on your Linux machine. For more information, see the [Sentinel LDK Getting Started Guide for Linux](#).
2. Disconnect your Sentinel HL key (if any) from the machine.
3. Copy the package **Linux/Redistribute/Runtime/aksusbd-9.12.1.tar.gz** to a local directory.
4. Open a terminal window in the local directory.
5. Enter the following command to uncompress the package containing the Run-time Environment installer:

```
tar zxvf aksusbd-9.12.1.tar.gz
```

6. Enter the following command to change to the directory containing the installer:

```
cd aksusbd-9.12.1
```

7. As **root**, enter the command: `./dinst`

The Sentinel LDK Run-time Environment is launched.

8. Reconnect the Sentinel HL key.

NOTE At this point, for older HASP HL keys, the firmware on the HL key may be automatically upgraded. During the upgrade process, the key will blink continuously. *Do not remove the key while it is blinking.* If you remove the key too soon, the key may no longer be visible in Admin Control Center. If the key is not visible, or if the upgrade does not occur, see ["Upgrading HASP HL Key Firmware" on page 55](#).

Uninstalling Run-time Environment v.1.14 or Earlier

An existing installation of the Run-time Environment v.1.14 or earlier cannot be upgraded and must therefore be uninstalled. (Run-time Environment v.1.15 or later *can* be upgraded.)

Before installing the new Run-time Environment, enter the following command to uninstall an existing Run-time Environment v.1.14 or earlier (if present):

- > For RedHat: `rpm -e aksusbd-redhat`
- > For SUSE: `rpm -e aksusbd-suse`

If the existing Run-time Environment was installed using the Run-time Environment installation script (**dinst**), remove this installation by entering following command as **root** from within the script package: `./dunst`

Installed Files

After you run the installation, verify that the following files are installed:

- > `/usr/sbin/aksusbd` and `/usr/sbin/aksusbd_x86_64`

32-bit and 64-bit support for Sentinel HL (HASP configuration) keys and HASP HL keys, and support for low-level access to the Sentinel License Manager daemon.

- > `/etc/init.d/aksusbd` or `/etc/init.d/aksusbd_x86_64`

32-bit or 64-bit startup script for Sentinel License Manager daemon. This file is not installed for Linux systems that use **systemd**. The file is installed only for old systems that use **sysv**.

- > `/usr/sbin/hasplmd` and `/usr/sbin/hasplmd_x86_64`

32-bit and 64-bit Sentinel License Manager daemons

- > `/etc/udev/rules.d/80-hasp.rules`

Rules for `/udev`

Following successful installation, the Sentinel LDK Run-time Environment is automatically launched. The first time that you run Admin Control Center and submit configuration changes, **hasplmd** creates a **hasplm.ini** configuration file in **/etc/hasplm**. In addition, log files are created in **/var/hasplm/**.

Uninstalling Sentinel LDK Run-time Environment

To uninstall Sentinel LDK Run-time Environment v.1.15 or later, when installed using RPM or DEB:

- > For RedHat, SUSE, or CentOS: As root, enter the command:

```
rpm -e aksusbd
```

- > For Debian or Ubuntu: Enter the command:

```
dpkg -r aksusbd
```

For some earlier Ubuntu systems, it may be necessary to specify that this is an i386 package. Enter the command:

```
dpkg -r aksusbd:i386
```

To uninstall Sentinel LDK Run-time Environment when installed using “dinst”:

- > As root, open a terminal window and enter the command:

```
./dunst
```

The **dunst** script can be found in the directory containing the **dinst** script, described in ["Installing Sentinel LDK Run-time Environment" on page 51](#).

Upgrading HASP HL Key Firmware

The Firmware for older HASP HL keys has been modified to support future planned security enhancements in Sentinel LDK. Sentinel LDK automatically upgrades the Firmware on HASP HL keys from v.3.21 to the latest version (v.3.25). This occurs:

- > when a HASP HL key with v.3.21 Firmware is connected to a computer where the Run-time Environment is being updated to v.1.15.
- > when a customer connects a HASP HL key with v.3.21 Firmware to a computer where the Run-time Environment v.1.15 has been previously installed.

(You can determine the Firmware version of your HL key by viewing the key on the Sentinel Keys page of the Admin Control Center.)

For HL keys with Firmware earlier than version 3.21, the upgrade does not occur automatically. Customers can upgrade the Firmware to version 3.25 by applying the Firmware Update V2C. This is located on the machine where Sentinel LDK Vendor Suite is installed, in the directory:

`%ProgramFiles(x86)\Thales\Sentinel LDK\Redistribute\Firmware Update\HASP HL\`

During the Firmware upgrade, the relevant key will start to blink. Do not remove the key while it is blinking. If you remove the key too soon, the key may no longer be visible in Admin Control Center.

NOTE In the event the key is no longer visible using the Linux Run-time Environment, do the following on a Windows computer:

1. Install Sentinel LDK Run-time Environment.
2. Connect the HL key.
3. Run the application **FirmwareUpdate.exe**. This is located in the directory described above. The HL key is upgraded to v.3.25 Firmware and will now be visible in the Linux Admin Control Center.

Installing Sentinel LDK Run-time Environment for Windows

Sentinel LDK Run-time Environment may be required:

- > at the vendor's site, to perform many activities using Sentinel EMS. In this case, the Run-time Environment is typically installed by the Sentinel LDK installer.
- > at the customer's site, to perform online activation of SL AdminMode keys using the Sentinel EMS Customer Portal.
- > at the customer's site, for your protected applications to run. Depending on the type of protection key provided, the Run-time Environment may be required at the site.

For more information, see the [Sentinel LDK Software Protection and Licensing Guide](#).

This section describes how you can install the Run-time Environment when it is required for your protected application (and it has not been installed automatically from the Customer Portal).

For information on supported platforms for Sentinel LDK Run-time Environment, see the [Sentinel LDK Release Notes](#).

The following utilities are available for installing the Sentinel LDK Run-time Environment at the end user's site:

- > A stand-alone GUI installer (HASPUserSetup.exe)
- > A command line installer that you can integrate into your software installer (haspdinst.exe)

These utilities recognize the operating system in use and install the correct Run-time environment.

NOTE Administrator privileges are required to install the Sentinel LDK Run-time Environment.

In this section:

- > ["HASPUserSetup.exe Utility" below](#)
- > ["haspdinst.exe Utility" on the next page](#)
- > ["Multiple Installations on a Single End User's Computer" on page 58](#)

HASPUserSetup.exe Utility

HASPUserSetup.exe is a GUI-based installation program to independently install the Sentinel LDK Run-time Environment. Following installation, the file is located in:

%ProgramFiles(x86)%\Thales\Sentinel LDK\Redistribute\Runtime Environment\Setup

To launch the utility, double-click HASPUserSetup.exe and follow the wizard instructions.

NOTE The HASPUserSetup.exe utility automatically installs the Run-time Environment with or without legacy drivers, as required. If you need to force installation of legacy drivers, use the ["haspdinst.exe Utility" below](#). For more information, see the description of legacy drivers in the [Sentinel LDK Software Protection and Licensing Guide](#).

haspdinst.exe Utility

haspdinst.exe is a command-line utility that installs the Sentinel LDK Run-time Environment. Following installation, the file is located in:

%ProgramFiles(x86)%\Thales\Sentinel LDK\Redistribute\Runtime Environment\cmd Install

NOTE By default, the haspdinst.exe utility automatically installs the Run-time Environment with or without legacy drivers, as required. If necessary, you can force installation of legacy drivers using the relevant switch described in ["Additional haspdinst.exe Utility Switches" below](#). For more information, see the description of legacy drivers in the [Sentinel LDK Software Protection and Licensing Guide](#).

To install or upgrade the Sentinel LDK Run-time Environment:

- > Type `haspdinst -i` in the command line. The installation or upgrade process is performed automatically. A message is displayed informing you that the Sentinel LDK Run-time Environment was successfully installed.

Immediately after the Run-time Environment (7.100 or later) is installed or upgraded, any V2C file contained in the same folder is applied to the relevant protection key on the machine.

To remove the Sentinel LDK Run-time Environment:

- > Type `haspdinst -r` in the command line. A message is displayed informing you that the Sentinel LDK Run-time Environment was successfully removed.

Additional haspdinst.exe Utility Switches

The following table lists additional switches that can be used with the haspdinst.exe utility.

Switch	Description
-info	Displays the installation status
-h or -?	Displays a list of the available commands
-kp	Enables the installation program to 'kill' all processes accessing the Run-time Environment

Switch	Description
-cm	Sets the installation program to display only critical messages (for example, instructions to reboot)
-fr	Sets the installation program to remove Sentinel LDK Run-time Environment by force, leaving the run-time in a non-functioning state
-ld	Forces installation of the Run-time Environment with legacy drivers. For details, see the Sentinel LDK Software Protection and Licensing Guide . For example: <code>haspdinst -i -ld</code>
-fi	Sets the installation program to ignore other running Windows processes
-nomsg	Sets program to display no messages
-chkllm	If used in conjunction with the <code>-i</code> or <code>-r</code> switch, checks for active License Manager sessions and prompts the user to continue or to abort the operation.
-fss	Silently stops “HASP Loader” and “Server” services (if they are active), performs the requested operation, and then restarts the services.

Multiple Installations on a Single End User’s Computer

The Sentinel LDK Run-time Environment installer utilities contain an automatic mechanism that prevents more than one copy of the Run-time Environment from being installed on a single computer, even if multiple protected applications are installed on the computer.

The Run-time Environment installer utilities employ a counter that keeps track of the number of protected applications installed on a given computer.

For each installation after the first, the installer simply increments the counter instead of actually installing an additional copy of the Run-time Environment. Similarly, the counter is decremented each time the Run-time Environment is uninstalled.

The Run-time Environment is not actually uninstalled until the last protected application is uninstalled.

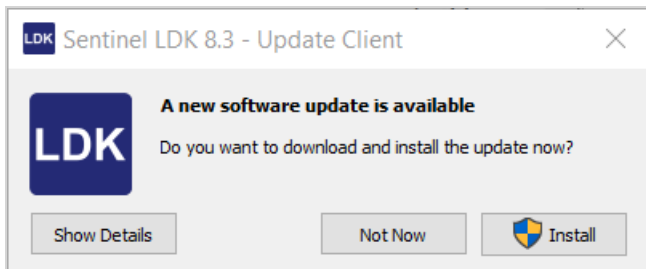
CHAPTER 6: Installing Software Updates

On the Windows machine where Sentinel Vendor Suite is installed, the Sentinel LDK software manager checks to determine whether a later version of the software is available from Thales servers. This helps to ensure that you are aware of important updates and that you are always working with the latest version of Sentinel LDK.

An update may consist of a new version of Sentinel LDK or an update to individual components or documents.

Each day, the software manager checks for the availability of any updates to the installed components of Sentinel LDK. The check takes place at the same time of day that the components were installed. Only one update notification is delivered on any given day.

If the software manager determines that an update is available, a message window similar to the following is displayed:



The title of the window identifies the component of Sentinel LDK to which the update applies, followed by "Update Client".

For more information regarding the update, click **Show Details**. A window similar to the following is displayed:



This window lists details of the update.

At this point, you can choose to:

- > Click **Install** to download and install the updated version.

NOTE Before you click this option, be sure to close any active Sentinel LDK applications.

- > Click **Not Now** (or just close the window) to postpone the update. The notification will be displayed again the next day.
- > Click **Ignore Update**. You will not receive any more notifications regarding this specific update.

CHAPTER 7: Modifying and Uninstalling Sentinel LDK Components

This section describes how to add Sentinel EMS or Sentinel LDK Vendor Suite to an existing installation of Sentinel LDK, and how to uninstall Sentinel LDK components from your computer.

Modifying the Installed Sentinel LDK Components

After installing one of the two major Sentinel LDK components, you may want to add the second component on the same machine. For example, you may have installed only the Sentinel EMS launcher, and now you want to add the Vendor Suite on the same machine (or vice versa).

To add the second component on the same machine as the first component:

1. Run the **setup** procedure from the Sentinel LDK Installation directory and select the **Modify** option.

NOTE Do not use the **Change > Modify** option that is available from the Programs and Features window in the Control Panel.

2. From the Installation Options screen, select the Sentinel LDK component to add.
3. Complete the installation process as described earlier in this guide.

Uninstalling Sentinel LDK Vendor Suite

This section describes how to completely uninstall the current version of Sentinel LDK Vendor Suite from your computer. To uninstall earlier versions of Sentinel LDK or Sentinel HASP, see the appropriate version of the Sentinel LDK Installation Guide.

To completely uninstall Sentinel LDK Vendor Suite from your computer:

1. Ensure that all Sentinel LDK components are not active.
2. On the computer where you want to uninstall Sentinel LDK, open the **Programs and Features** window from the Control Panel.

3. Remove the following:

- Sentinel LDK
- Sentinel Runtime
- Sentinel LDK Vendor Suite

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smali/baksmali

Version 2.2.4

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LibJpeg8

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JSMN 1.1.0

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