Progress®
Kemp® LoadMaster®

Feature Description SSL Accelerated Services

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Introduction

Progress Kemp leads the industry in driving the price/performance value proposition for application delivery and load balancing to levels that our customers can afford. Our products' versatile and powerful architecture provide the highest value, while enabling our customers to optimize their businesses that rely on Internet-based infrastructure to conduct business with their customers, employees and partners.

Progress Kemp products optimize web and application infrastructure as defined by high-availability, high-performance, flexible scalability, security and ease of management. They maximize the total cost-of-ownership for web infrastructure, while enabling flexible and comprehensive deployment options.

When creating a HTTPS Virtual Service on the LoadMaster, by default the system creates it without SSL offloading enabled. To take advantage of the SSL offloading and security capabilities of the LoadMaster, you can enable **SSL Acceleration** under **SSL Properties** in the Virtual Service modify screen. By default, the LoadMaster assigns a self-signed certificate to the service, but you can import your own including the correct chain root and intermediate certs for your site and assign it to your Virtual Service.

To help with security on the client-side connection, we recommend using SSL offloading/re-encryption with the following options:

- Enable **TLS1.2** and **TLS1.3** only
- Use the **BestPractices Cipher Set**
- Enable **Require SNI hostname**
- For logging purposes, enable **Add Received Cipher Name**
- Enable **Strict Transport Security Header**

- For logging purposes, under **Advanced Properties** - select **X-Forwarded-For (+ Via)** for **Add HTTP Headers**

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- Document Purpose
- Intended Audience

Document Purpose

This document describes various aspects of SSL Accelerated Services using the LoadMaster. It describes in detail how to configure SSL Accelerated Services using the LoadMaster Web User Interface (WUI).

Intended Audience

This document is intended to help anyone who wishes to learn about or implement the SSL Accelerated Services within the LoadMaster.

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Create an SSL Accelerated Virtual Service

This section will explain how to create a Virtual Service with SSL Acceleration activated.

SSL Acceleration transfers the processing of SSL from the Real Servers to the LoadMaster, meaning that only one certificate is required per Virtual Service.

Note: When SSL Acceleration is enabled, communication from the LoadMaster to the Real Servers is unencrypted.

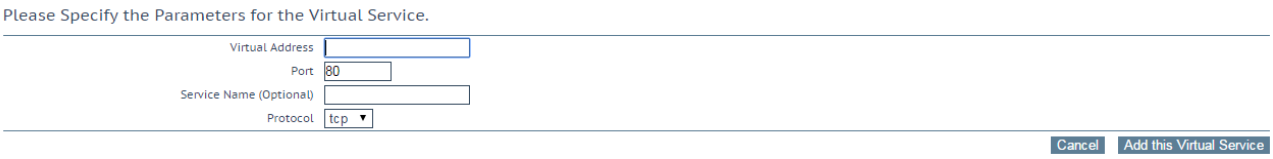
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- How to Export SSL Certificates from a LoadMaster Certificate Backup
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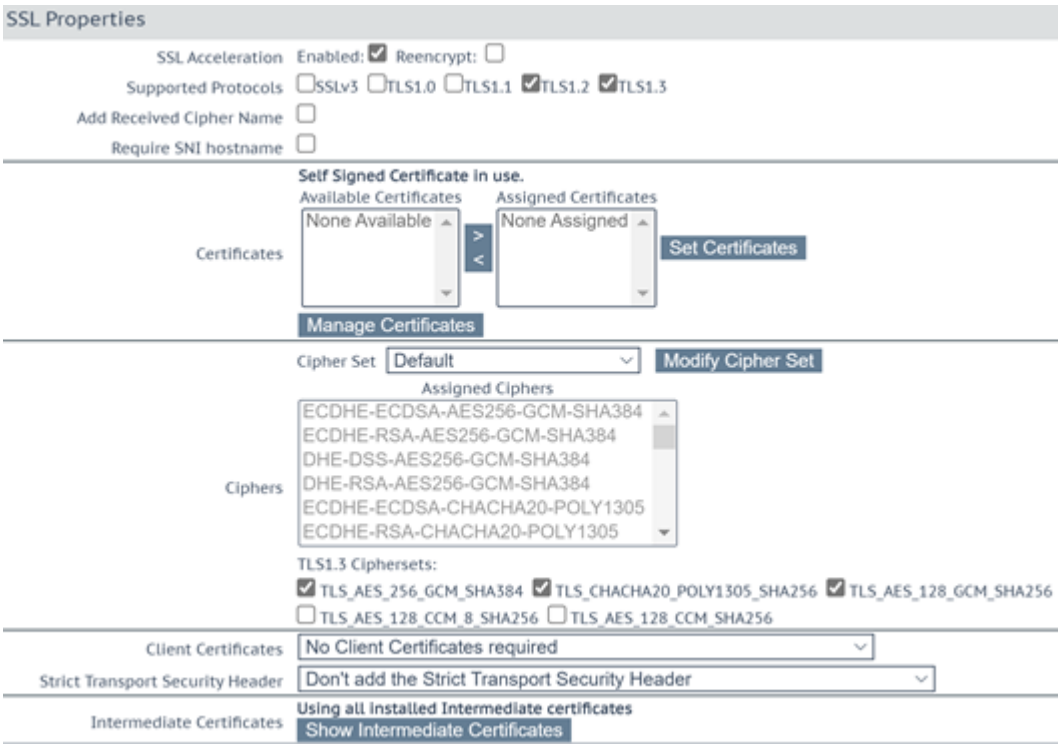
Adding an SSL Virtual Service

The process for adding an SSL-enabled Virtual Service is the same for a regular Virtual Service. First, add the Virtual Service. In the main menu of the LoadMaster WUI, select **Virtual Services** and **Add New**. A screen will appear asking to enter the **Virtual Address**, **Port**, **Service Name** and **Protocol**.



The port defaults to port **80**, which is the standard HTTP port. If an SSL-enabled Virtual Service is being created, change the port to **443**, which is the default HTTPS port. Keep the protocol as **tcp**, and click **Add this Virtual Service**.

The Virtual Service properties screen will appear. Among the various sections in this screen is **SSL Properties**.



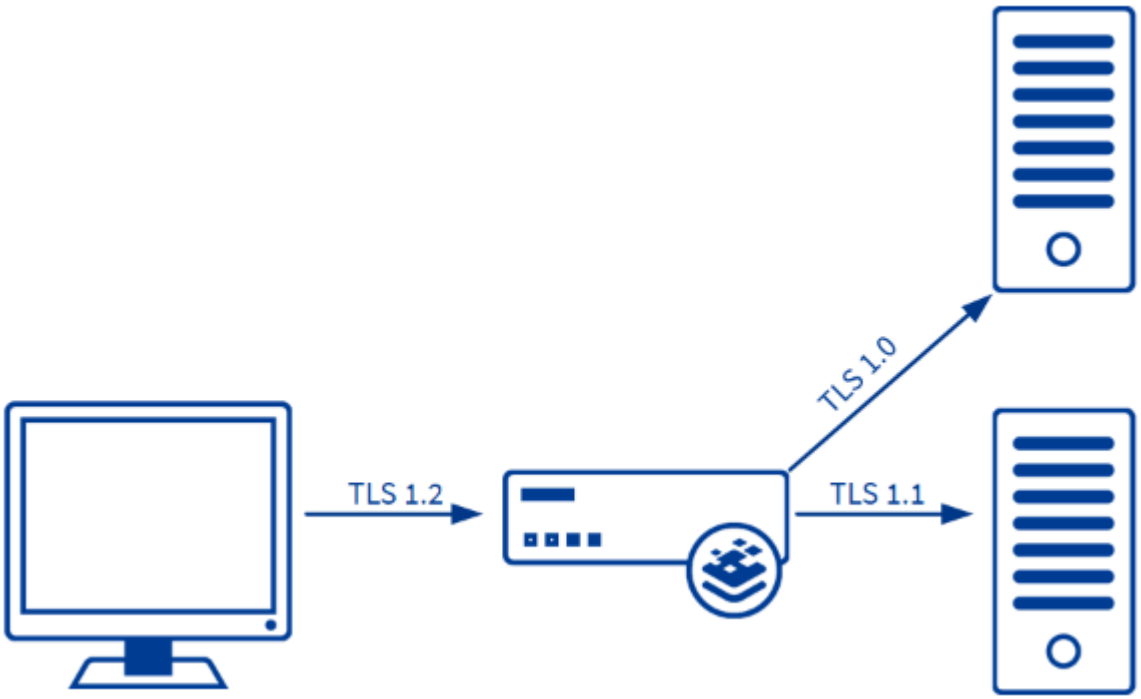
To enable SSL for this Virtual Service, select the **Enabled** check box.

A warning will appear saying that a temporary certificate will be used for the service. Click **OK**.

As soon as SSL is enabled, the LoadMaster will install a self-signed certificate for the Virtual Service.

The check boxes in the **Supported Protocols** section allow you to specify which protocols should be supported by the Virtual Service. By default, TLS1.1, TLS1.2, and TLS1.3 protocols are enabled and SSLv3 and TLS1.0 are disabled.

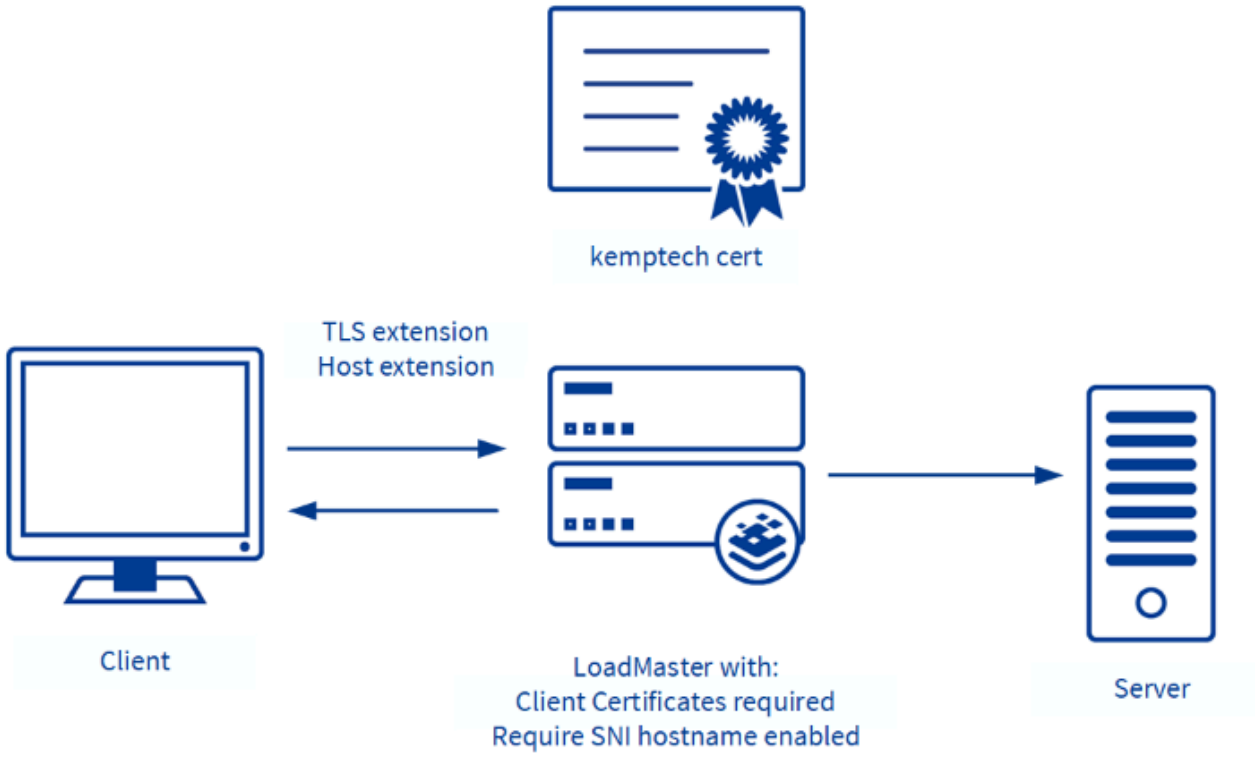
Starting with version 7.2.37, when re-encryption is enabled, the TLS version that can be negotiated between the LoadMaster and the Real Servers behind it are no longer constrained by the TLS version settings configured on the client side. All TLS versions and ciphers that are supported on the LoadMaster can be negotiated without restriction by Real Servers. In this way, the LoadMaster can, for example, provide strict security for client-side application access and still support server-side connections to legacy servers that only support specific, less secure, TLS versions, and ciphers. This is illustrated in the example below.



Server connections are only restricted by the configuration of the Real Servers, regardless of the TLS version selected on the client side. Each Real Server can be configured independently of the others. The LoadMaster negotiates connections according to the requirements of each Real Server.

Selecting the require Server Name Identifier (SNI) hostname check box means that the hostname will always be required to be sent in the TLS client hello message.

When **Require SNI hostname** is disabled, the first certificate in the list of **Assigned Certificates** as a host header match is not found.



When **Require SNI hostname** is enabled, a certificate with a matching host name must be found, otherwise the connection is dropped. This also supports wildcard certificates.

Multiple certificates are supported. Wildcard certificates work regardless of what position they are in. SNI can find certificates by Subject Alternative Name (SAN) when the certificate is not in the first position. SNI will choose the first matching certificate in a list if multiple certificates contain the same name in either the Common Name or SAN name.

Note: When using a Subject Alternative Name (SAN) certificate, alternate source names are not matched against the host header.

Note: Wildcard certificates are supported but please note that the root domain name will not be matched as per RFC 2459. Only anything to the left of the dot will be matched. Additional certificates must be added to match the root domain names. For example, www.kemptechnologies.com will be matched until a wildcard of *.kemptechnologies.com. Kemptechnologies.com will not be matched.

After you have added certificates to the LoadMaster (see the Adding an SSL Certificate section) you can assign one or more certificates to the Virtual Service by selecting them in the **Available Certificates** list, clicking the right arrow and clicking the **Set Certificates** button. Both internal and external certificates can be assigned to the same Virtual Service.

There is a limit of 8171 characters when assigning certificates to a Virtual Service using the WUI.

A description of each of the options in the **Client Certificates** drop-down is provided below:

- **No Client Certificates required:** enables the LoadMaster to accept HTTPS requests from any client.

This is the recommended option.

By default the LoadMaster will accept HTTPS requests from any client. Selecting any of the other values below will require all clients to present a valid client certificate. In addition, the LoadMaster can also pass information about the certificate to the application.

Note: This option should not be changed from the default of **No Client Certificates required**. Only change from the default option if you are sure that all clients that access this service have valid client certificates.

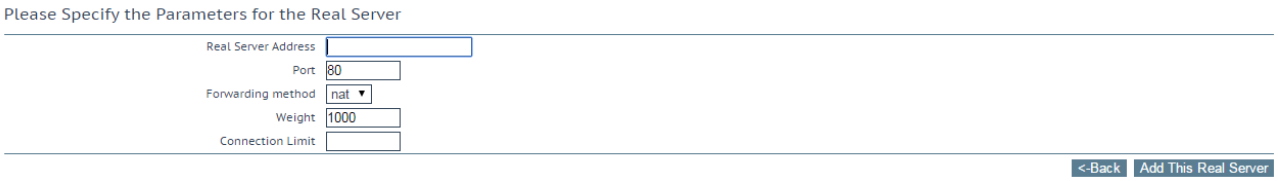
- **Client Certificates required:** requires that all clients forwarding a HTTPS request must present a valid client certificate.
- **Client Certificates and add Headers**: requires that all clients forwarding a HTTPS request must present a valid client certificate. The LoadMaster also passes information about the certificate to the application by adding headers. When a client certificate is used, the **X-SSL-ClientSerialid** header is set.
- The below options send the certificate in its original raw form. The different options let you specify the format that you want to send the certificate in:
- Client Certificates and pass DER through as SSL-CLIENT-CERT
- Client Certificates and pass DER through as X-CLIENT-CERT
- Client Certificates and pass PEM through as SSL-CLIENT-CERT
- Client Certificates and pass PEM through as X-CLIENT-CERT

If a Virtual Service:

- Has **SSL Acceleration** enabled, and
- Any of the client certificate required options with "pass through as SSL-CLIENT-CERT/X-CLIENT-CERT" is selected in the **Client Certificates** drop-down list, and
- A **Delete Header** rule is applied to that Virtual Service to delete the SSL/X-CLIENT-CERT header field, then

  The **Delete Header** content rule preserves the LoadMaster inserted client certificate header fields and removes any header with that name passed in by the client.

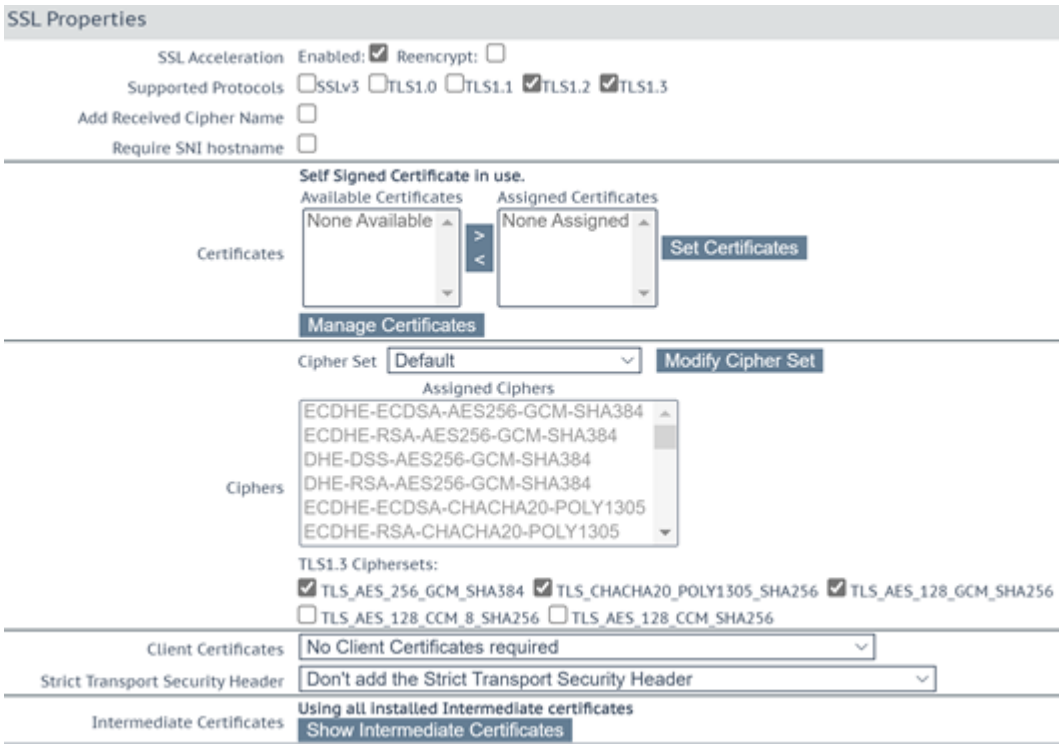
Real Servers can be added to this SSL Virtual Service by clicking **Add New** in the **Real Servers** section.



When adding Real Servers, ensure to add them on port **80** (or whatever port that the non-SSL service is running on), and not port 443.

Adding an SSL Certificate

If you have a Certificate Authority (CA)-signed certificate to use with an SSL-enabled Virtual Service, or have a custom self-signed certificate, this can be added to the Virtual Service through the WUI.



There is a button called **Manage Certificates** that you can click to add an (RSA or EC) SSL certificate.



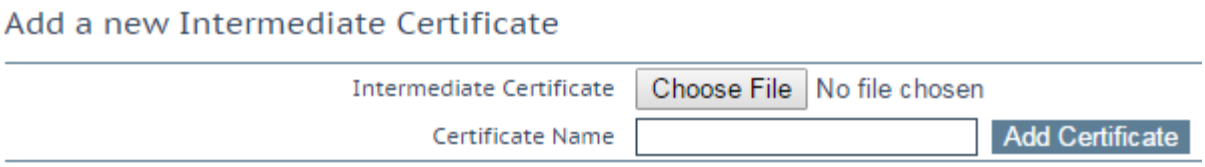
There is also an **Add New** button in the **View/Modify Services** screen in the **Certificates Installed** column.



Either route opens the same screen; the screen to input the certificate information.

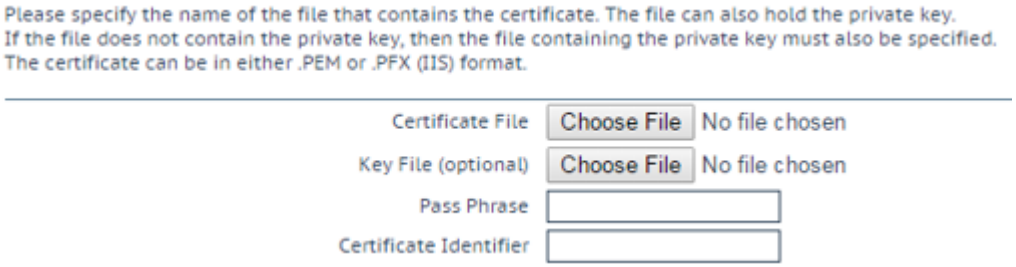
At this point there are two options; **Add Intermediate** and **Import Certificate**.

Add Intermediate



Clicking this button will allow you to add an intermediate certificate as a temporary measure. Browse to where the file is stored, enter the desired name in the **Desired File Name** field and click the **Add Certificate** button.

Import Certificate



The certificate and key file can be added from this screen. The two formats officially supported by the LoadMaster are .PEM and .PFX. However, other formats can also be imported to the LoadMaster. This document covers the .PEM, .PFX, and .CER certificate formats and the variations in which they can be added to the LoadMaster.

PFX (PKCS#12) Certificate Format

PFX or PKCS#12 format is a binary format for storing a server certificate, intermediate certificates, and the private key all in one encrypted file. PFX files can have the extensions .pfx and .p12. If the PFX format contains the private key, the key file does not have to be imported.

To import a PFX format certificate:

1. Select the .pfx or .p12 **Certificate File**.
2. If the PFX file does not contain a private key, select it using the **Key File** field.
3. Enter the **Pass Phrase** configured when creating the PFX certificate file.
4. Enter a **Certificate Identifier** which is the name used to identify the certificate on the LoadMaster.

PEM (X.509v3) Certificate Format

The PEM extension is used for different types of X.509v3 files which contain ASCII (Base64) armored data prefixed with a "—— BEGIN …" line. The .PEM certificate format that may include just the public certificate, or may include an entire certificate chain including public key, private key, and root certificates.

To import a PEM format certificate:

1. Select the .pem **Certificate File**.
2. If the .PEM file does not contain a private key, select it using the **Key File** field.
3. Enter the **Pass Phrase** configured when creating the PEM certificate file.
4. Enter a **Certificate Identifier** which is the name used to identify the certificate on the LoadMaster.

CER Certificate Format

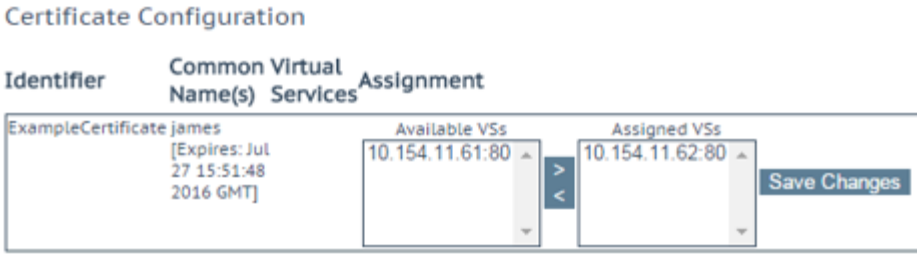
A CER file is used to store an X.509 certificate. The file contains information about certificate owner and public and private certificate keys. A CER file can be in binary (ASN.1 DER) or encoded with Base-64 with a header and footer included (PEM). Windows recognizes either of these layouts. Though the .CER certificate file contains information about the private key, it does not contain the private key file and should be included when importing the .CER certificate file to the LoadMaster.

To import a .CER certificate:

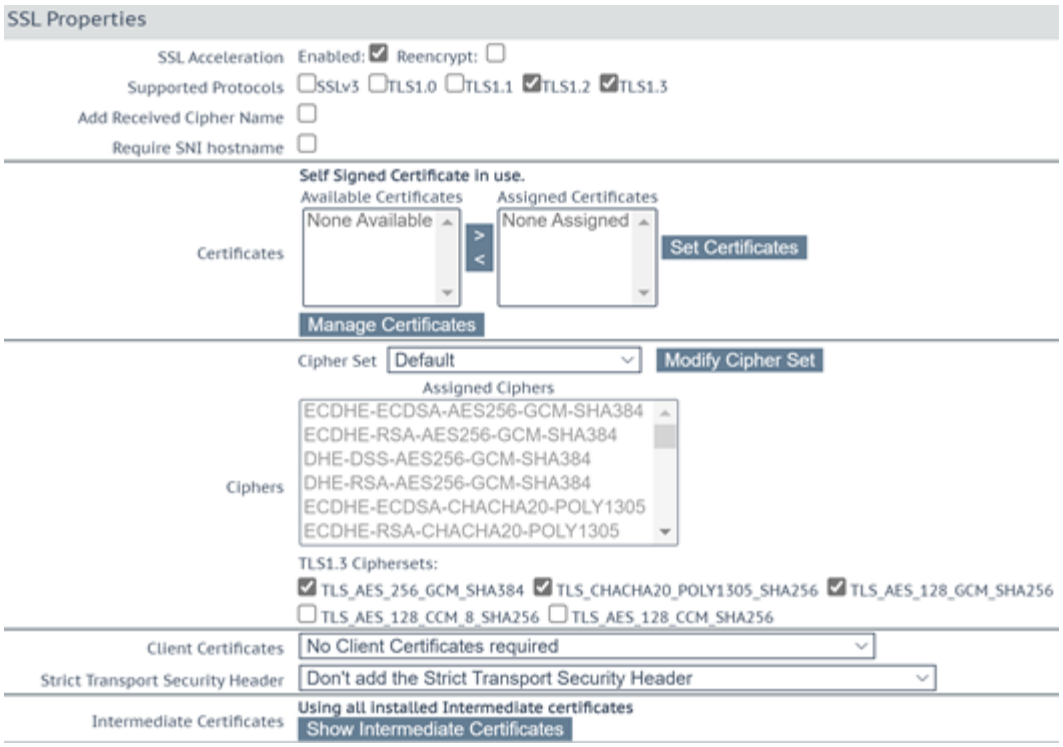
1. Select the .pem **Certificate File**.
2. Select the private key file using the **Key File** field.
3. Enter a **Certificate Identifier** which is the name used to identify the certificate on the LoadMaster.

Note: The certificate file cannot have the following in the filename: **ident**, **cfile**, **kfile**, **ffile**, **replace**, **password**. If it does, an **Invalid Certificate Identifier** error message appears.

Note: Transactions Per Second (TPS) Performance will vary based on key length. Larger keys will reduce performance.



After importing a certificate, it can then be assigned to a Virtual Service(s) by selecting the relevant IP address(s) in the **Available VSs** list, clicking the right arrow and clicking **Save Changes**.



Certificates can also be assigned to a Virtual Service within the Modify Virtual Service screen.

If you add a certificate to the LoadMaster in version 7.2.51 or later (or in 7.2.48.3 LTS or a later LTS version) and then downgrade to 7.2.50 or an earlier version (or 7.2.48.2 LTS or an earlier version) - the certificate will not work. To work around this, create a backup of all SSL certificates before downgrading and then restore the certificates after downgrading (**Certificates & Security > Backup/Restore Certs**). If you forget to take the backup before downgrading: upgrade the firmware again, take the certificate backup, downgrade, and then restore the certificate backup.

Replacing a Certificate on the LoadMaster

When a certificate has expired, you must renew and update your existing certificate on the server and on the LoadMaster if **SSL Acceleration** is enabled on your Virtual Service.

To replace certificate on the LoadMaster, follow these steps:

1. In the main menu, select **Certificates & Security > SSL Certificates**.
2. Identify the certificate that has expired and click the **Replace Certificate** button for that certificate.

   Note: You cannot delete or replace Let's Encrypt/DigiCert certificates from the **SSL Certificates** screen. You can only delete or replace Let's Encrypt/DigiCert certificates from **Certificates & Security > ACME Certificates**. The **Replace Certificate** and **Delete Certificate** buttons are grayed out on the **SSL Certificates** screen for Let's Encrypt/DigiCert certificates.

3. In the **Certificate File** field, click **Choose File** and select renewed certificate.

   Note: The LoadMaster only accepts certificates in .PFX or .PEM format.

4. Select the **Key File** (private key) if required.
5. Enter the **Pass Phrase** (password) assigned to this certificate.
6. Click **Save**.

The certificate is replaced and updated on the LoadMaster and Virtual Services.

Note: If you receive an error saying 'invalid passphrase' when saving the certificate, this might mean you have incorrectly entered the password for this certificate and will need to enter the correct password. This can also mean that passphrase was not accepted due to the character content. The **Pass Phrase** must be alpha-numeric, case sensitive, and have a maximum of 64 characters to be accepted by the LoadMaster.

Checking Certificate Installations

Some browsers have functionality that allows a check of the nature of the certificate installed on the website being connecting to. This can be useful when troubleshooting a certificate problem.

When browsing an SSL site, HTTPS should be displayed in the address and there may be an icon signifying a secure link (a padlock icon).



The icon can be clicked to see information about the certificate that is used with that SSL site.

Intermediate Certificates

Some certificates issued by Certificate Authorities require a third certificate, often referred to as an intermediate certificate. This additional certificate provides a chain path from the CA to the certificate issued to your site.

While some CAs use intermediate certificates, others do not. If you have questions on whether or not you should have received an intermediate certificate from your CA vendor, contact your CA vendor.

If a CA certificate has been installed, and an SSL error appears when browsing the Virtual Service, it is likely that an intermediate certificate needs to be installed.

Uploading several consecutive intermediate certificates within a single piece of text, as practiced by some certificate vendors such as GoDaddy, is allowed. The uploaded file is split into individual certificates.

Importing Intermediate Certificates

Installing an intermediate certificate is simple to do through the WUI. First, obtain the intermediate certificate from the CA. This can usually be found on their web site, and is usually in a text window to make it easier to cut and paste.

Note: Your CA vendor may have provided the required intermediate certificates in the same bundle as the certificate itself, and so these would be installed together. The method documented in this section should be used when you are installing one or more intermediate certificates alone.

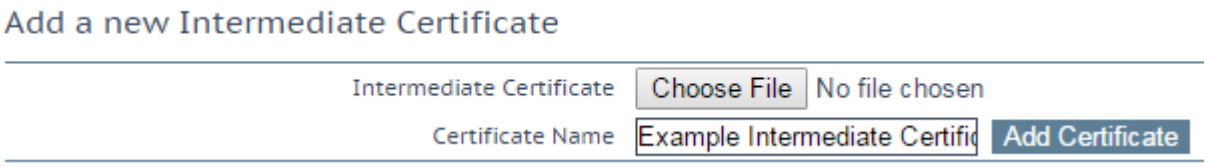
The intermediate certificate formats that are officially supported by the LoadMaster are: .PEM, .CER, and .CRT.

A CER file can only be encoded and exported in Base-64 format for it to be uploaded to the LoadMaster. A CER file exported in a DER binary format is not supported on the LoadMaster and the LoadMaster is unable to upload this format.

This section provides steps on how to apply and upload intermediate certificates and how to resolve any invalid certificate formats.

To import an intermediate certificate to the LoadMaster complete the following steps:

1. Navigate to **Certificates & Security > Intermediate Certs** in the main menu.



2. Click **Choose File**.
3. Browse to and select the required intermediate certificate file.
4. Enter the **Certificate Name**. This name is used on the LoadMaster to help you manage your certificates.

5. Click **Add Certificate**.
6. Click **OK**.

These intermediate certificates do not need to be associated with any Virtual Service certificates. The LoadMaster automatically builds the required certificate chain.

Also, only one intermediate certificate is required per CA. If several certificates have been installed from VeriSign, for instance, you only need to install the VeriSign intermediate certificate once.

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- Invalid Certificate Formats

Invalid Certificate Formats

If you follow the steps to upload an intermediate certificate to the LoadMaster and receive a **Certificate Format Invalid** error, it means the certificate file you are trying to upload is unsupported or is not in one of the formats required by LoadMaster (PEM, CER, CRT).

The standard PEM file format can be uploaded to the LoadMaster.

A CER file is used to store an X.509 certificate. A CER file can only encoded and exported in Base-64 format to upload to the LoadMaster. A CER file exported in a DER Binary format is not supported on the LoadMaster and the LoadMaster is unable to upload this format.

To convert a CER file into a PEM format, you can use an SSL Converter Tool, such as this one: SSL Converter.

Follow these steps to convert a certificate using the SSL Converter Tool:

1. Go to the following link: SSL Converter.
2. Browse to and select the **Certificate File to Convert**.
3. Select the current format type of the selected certificate file.
4. Select **Standard PEM** in the **Type to Convert To** drop-down list.
5. Click **Convert Certificate**.

You can upload this file format to the LoadMaster.

IIS Certificates

This section outlines how to migrate SSL from Microsoft Internet Information Services (IIS) to the LoadMaster.

When putting a LoadMaster in a situation where a Microsoft IIS server was previously performing SSL, there is an option to import the IIS certificate into the LoadMaster. This SSL certificate can be migrated from Microsoft IIS to the LoadMaster by completing two simple tasks. The first task is to export the SSL certificate from the IIS using Microsoft export tools; ensure to export the certificate and private key as a Personal Information Exchange File (PFX). The second step is to import the PFX file into the LoadMaster using the LoadMaster WUI. To start the import process on the LoadMaster simply click the **Add New** button in the SSL enabled Virtual Service and install the certificate as per the instructions in the Adding an SSL Certificate

section.

Exporting a PFX Certificate from IIS

When enabling SSL offloading on a Virtual Service, you must upload a certificate to the LoadMaster. If you are load balancing a Microsoft application, you can export this certificate from IIS and upload it to the LoadMaster.

Here are the steps to do this:

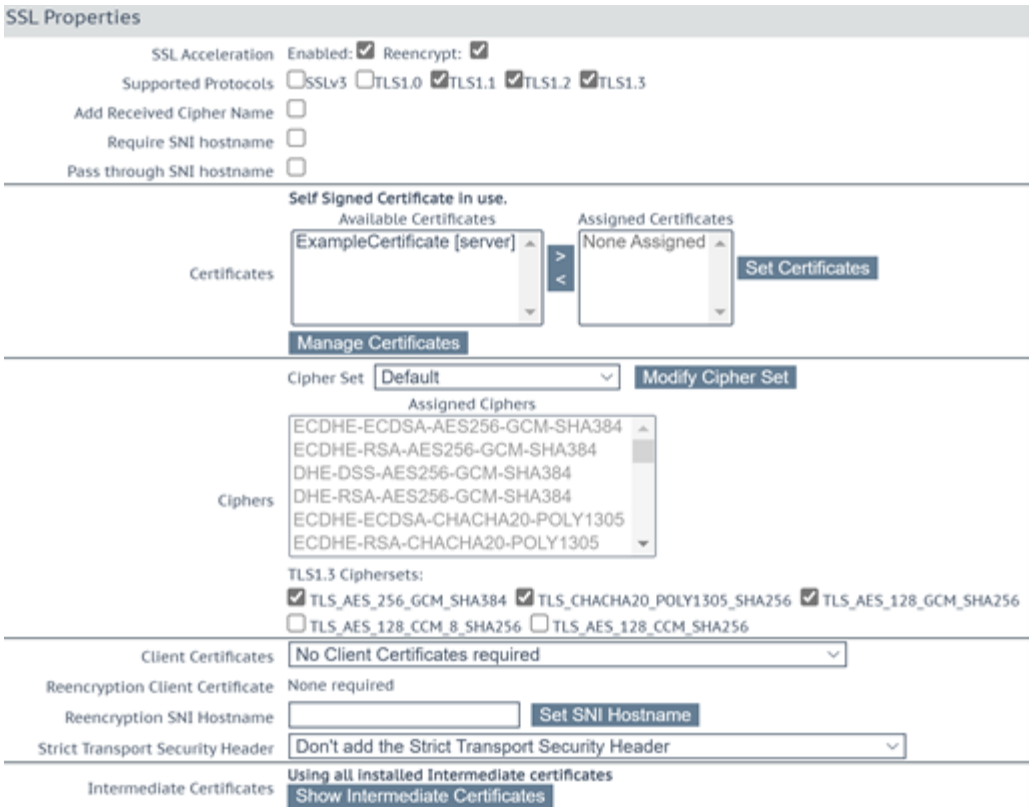
1. Log in to your IIS Server.
2. On the **Start** menu click **Run** and then type **mmc**.
3. Click **File > Add/Remove Snap-in**.
4. Click **Certificates > Add**.
5. Select **Computer Account** and then click **Next**.
6. Select **Local Computer** and then click **Finish**.
7. The certificates have now been added to your snap-ins. Click **OK**.
8. Under **Console Root**, expand the **Certificates** console tree.
9. Select **Trusted Root Certification Authorities** and expand the **Certificates** folder.
10. Right-click the certificate you want to export, go to **All Tasks** and click **Export**.
11. Run the **Certificate Export Wizard** and click **Next**.
12. Click **Yes, export the private key**.
13. Select **Personal Information Exchange - PKCS #12 (.PFX)** and select the **Include all certificates in the certification path if possible** check box. Click **Next**.
14. Enter the **Password** and confirm it.
15. Specify the certificate name and directory to store the certificate.
16. Click **Finish**. The certificate is exported.

After it is exported, you can upload the certificate (in .PFX format) to the LoadMaster. For more information and steps, refer to the Adding an SSL Certificate section.

Re-encrypt SSL

With SSL acceleration, the SSL session is terminated at the LoadMaster, and sent to the Real Servers unencrypted. In some security situations, it may be necessary to encrypt the connection between the LoadMaster and Real Servers. This can be done with reencrypt SSL.

With reencrypt SSL, the SSL session is first terminated at the LoadMaster. Persistence and other Layer 7 functionality can then be performed. After that, the traffic is re-encrypted in a new SSL session between the LoadMaster and the Real Server.



This is turned on by a single option in the properties screen of a Virtual Service in the SSL section.

Note: The TPS value reported on the LoadMaster **Home** screen only counts the decrypting transactions (the re-encrypting transactions are not counted). If **Reencrypt** is enabled for a Virtual Service, you can roughly double the number. For example, if five Virtual Services are enabled for SSL offloading and only one Virtual Service is enabled for re-encrypting, then double the TPS number for that one Virtual Service and add to the total to get the total value. Doubling only applies to Virtual Services that have re-encryption enabled.

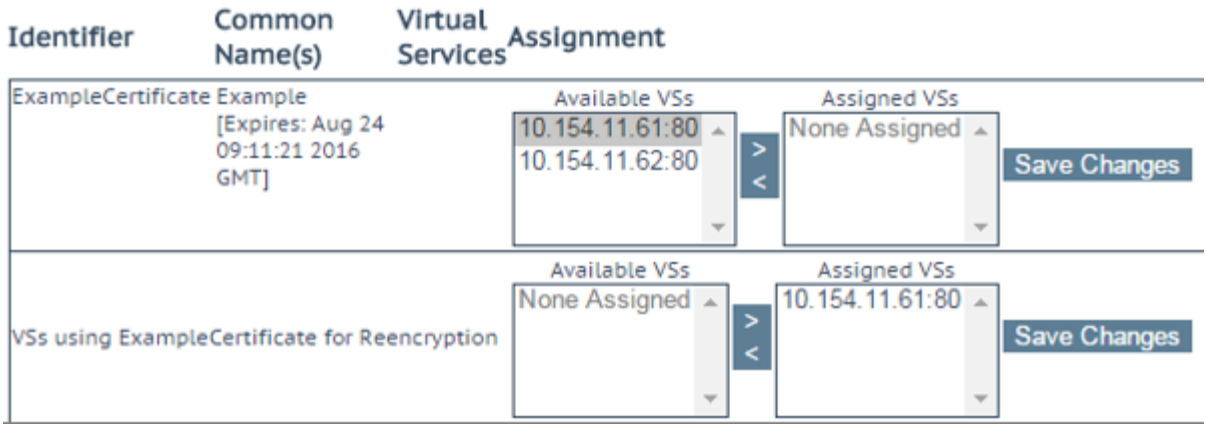
Assigning a Client Certificate for Re-encryption

It is possible to require client certificates when SSL re-encryption is enabled. To assign a client certificate for re-encryption, follow the steps below:

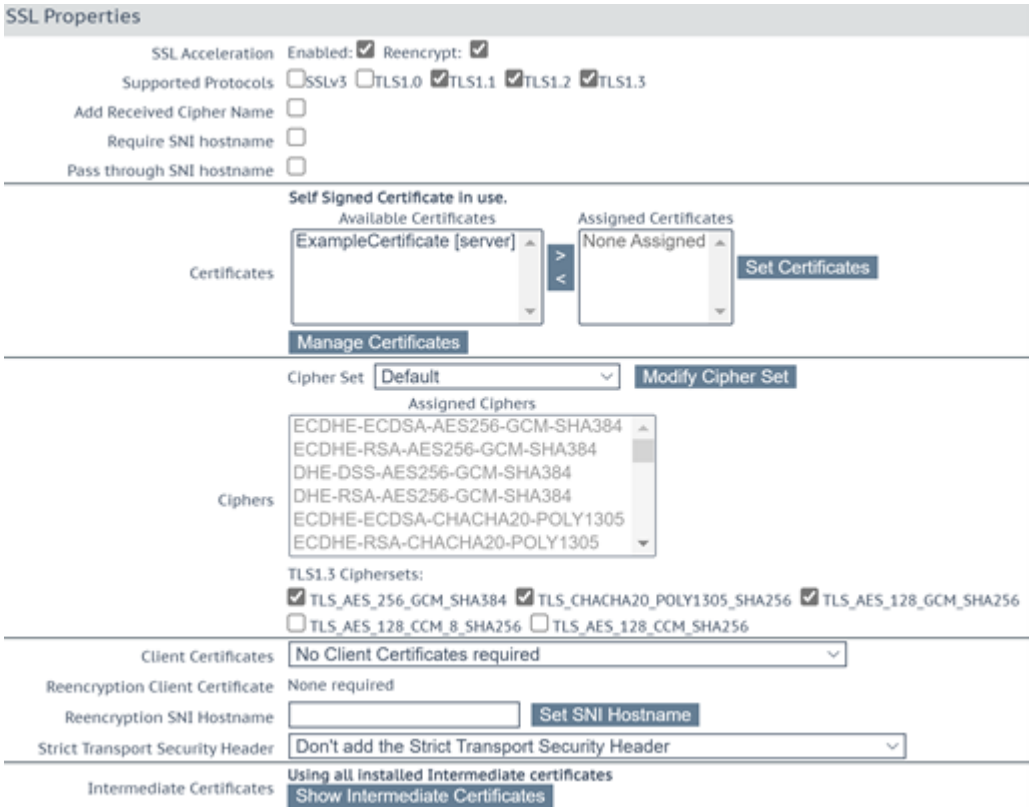
1. In the main menu of the LoadMaster WUI, go to **Certificates & Security > SSL Certificates**.



2. Click **Reencryption Usage** on the relevant certificate.



3. Select the relevant IP address from the **Available VSs** box.
4. Click the right arrow.
5. Click **Save Changes**.



The **Reencryption Client Certificate** is displayed in the **SSL Properties** section of the relevant Virtual Service.

Certificate Signing Request (CSR)

You can create a CSR for submission to your signing authority of choice. Using the WUI, navigate to **Certificates & Security > Generate CSR**. Fill in the information and click **Create CSR**. CSRs generated by

the LoadMaster use SHA256.

CAUTION: Store the private key in a vault. The private key will be required once the authority creates the certificate.

Backup/Restore Certificates

The LoadMaster supports exporting of all certificate information. This includes private key, host and intermediate certificates. The export file is designed to be used for import into another LoadMaster and is encrypted.

To back up certificates that have been uploaded to the LoadMaster, follow the steps below:

1. In the main menu of the WUI, go to **Certificates & Security > Backup/Restore Certs**.
2. In the **Certificate Backup** section, enter a **Passphrase**.

   Note: This **Passphrase** is required when restoring the backup. If it is forgotten, there is no way to restore the certificates.

   Note: The **Passphrase** must be alpha-numeric. It is case sensitive. A maximum of 64 characters is allowed.
3. Click **Create Backup File**. The backup is downloaded.

To upload certificates that have been backed up from the LoadMaster, follow the steps below:

1. In the main menu of the WUI, go to **Certificates & Security > Backup/Restore Certs**.
2. In the **Restore Certificates** section, click **Choose File** and select the backup file that contains the LoadMaster certificates.
3. Select **Which Certificates** to restore:
   - All Virtual Services certificates and all intermediate certificates
   - Intermediate certificates only
   - Virtual Services certificates only
4. Enter the **Passphrase**.
5. Click **Restore Certificates**.

The specified certificates are restored to the LoadMaster.

How to Export SSL Certificates from a LoadMaster Certificate Backup

To back up certificates and keys, follow the steps below in the LoadMaster WUI:

1. Go to **Certificates & Security > Backup/Restore Certs**.

2. In the **Certificate Backup** section, enter the desired **Passphrase** twice. This passphrase is needed when restoring the backup.
3. After the file is downloaded, rename it to **certbackup.gz**.
4. Once you have the .gz file, you can either unzip it from the command line using **gzip -d** or using a tool such as 7-Zip.
5. Rename the resulting file **certbackup.aes**.
6. Download and install OpenSSL from the web.
7. In OpenSSL, enter: **openssl enc -in certbackup.aes -out certbackup.tar -d -aes256 -md md5 -k passphrase**

   Note: Where **passphrase** is the **Passphrase** you entered when exporting the backup from the LoadMaster.

8. Untar the resulting file (**certbackup.tar**).

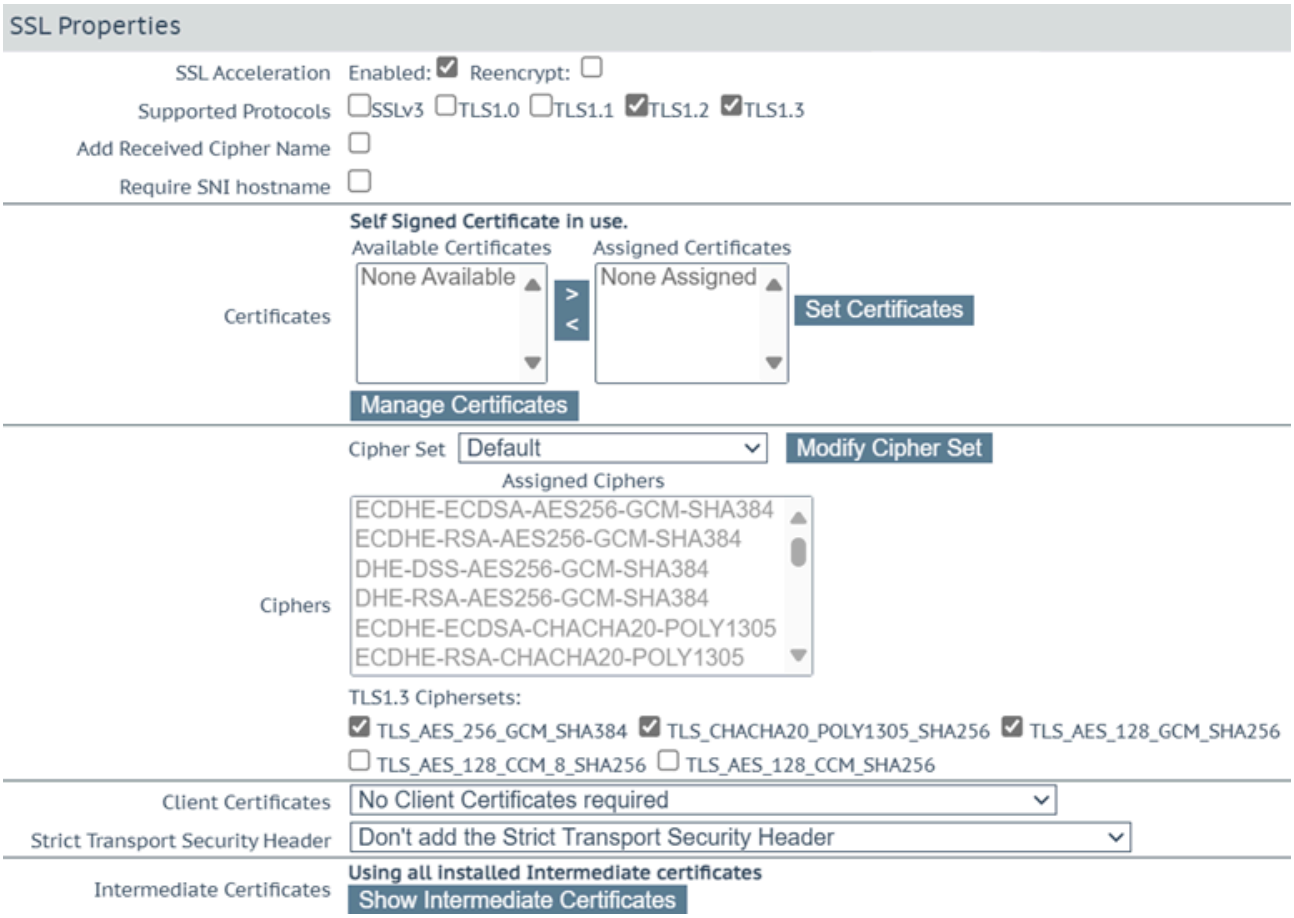
The resulting folder will contain your certificates.

Note: These files are in standard x.509 certificate format. You can use this certificate and key to import into IIS or any other web server that accepts standard x.509 certificates.

SSL Ciphers

The LoadMaster supports SSLv3, TLS1.0, TLS1.1, TLS1.2, and TLS1.3.

Ciphers define how the data stream is encrypted. The LoadMaster supports ciphers supporting perfect forward secrecy and Elliptic Curve.



Each Virtual Service (which has **SSL Acceleration** enabled) has a cipher set assigned to it. This can either be one of the system-defined cipher sets or a user-customized cipher set. The system-defined cipher sets can be selected to quickly and easily select and apply the relevant ciphers.

A cipher set also needs to be assigned to the LoadMaster WUI. To set the WUI cipher set, go to **Certificates & Security > Admin WUI Access**.

Note: CHACHA20-POLY1305 ciphers are given special preference when they appear in both the client and LoadMaster cipher lists. If these ciphers appear at the top of the client preference list, the LoadMaster will prioritize using CHACHA20-POLY1305 ciphers for the connection, regardless of the position of these ciphers in the LoadMaster's cipher list.

The system-defined cipher sets are as follows:

- **Default:** The cipher set that is configured on the LoadMaster on a fresh installation. This cipher set is geared towards backwards compatibility with previous releases of the LoadMaster.
- **Default_NoRc4:** A more secure version of the default set that does not contain any RC4 ciphers, which are considered to be insecure on modern networks.
- **BestPractices:** This is the recommended cipher set to use on the LoadMaster and it is updated occasionally to reflect the current industry best practices. It does not include older and legacy cipher sets which may be required by older browser and application deployments. The last update to the **BestPractices** set was made in LoadMaster version 7.2.60.0. Please see the LoadMaster Release Notes for more information.

- **Intermediate_compatibility:** This cipher set includes some ciphers that are required by older browser and service implementations that are still seen in the field.
- **Backward_compatibility:** This cipher set provides maximum backward compatibility for clients back to Windows XP/IE6 at the risk of using less secure ciphers.

Note: The **Backward_compatibility** cipher set should be used as a last resort only.

- **WUI:** This is the default cipher set used by the administrative user interface. It can be changed by using the controls under **Certificates & Security > Admin WUI Access**.
- **FIPS:** This set contains only ciphers that conform to Federal Information Processing Standards (FIPS) 140-2 level 1 standard and should be used only in those deployments that require it.
- **Legacy:** This cipher set is provided solely for upgrade compatibility for legacy LoadMaster firmware versions (v7.0-10 and previous). After upgrade to a modern version of LoadMaster, it is recommended to choose a more secure cipher set.
- **Null_Ciphers:** This cipher set contains what are called 'null ciphers', which do not provide any cryptographic protection, but rather depend on the application to provide it. In general, use these ciphers only if required by the application and if that application provides independent cryptographic protection.
- **ECDSA_Default:** This cipher set includes only cipher sets that use elliptical curve cryptography and is recommended for those deployments that require EC cryptography.
- **ECSDA_BestPractices:** This is a modified version of the **ECDSA_Default** set that includes only those ciphers that conform to the Common Criteria standards.

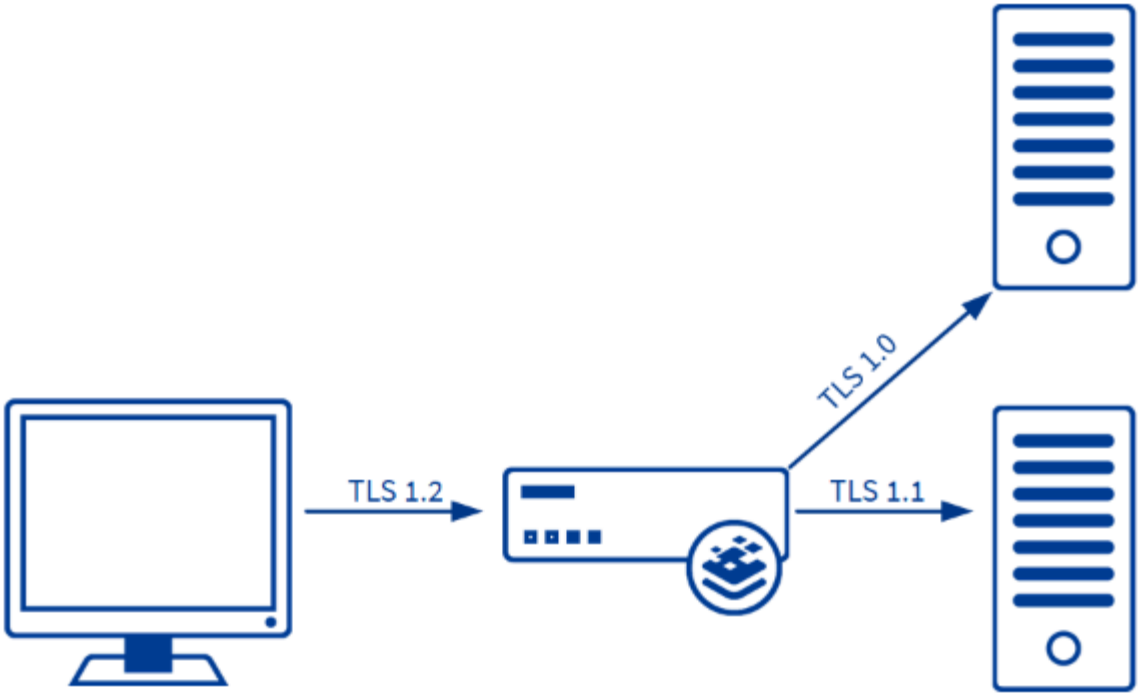
To find out what ciphers are in each cipher set, go to **Certificates & Security > Cipher Sets**. Select the relevant **Cipher Set**. Two lists are displayed – **Available Ciphers** and **Assigned Ciphers**. These lists can be filtered by typing some text into the **Filter** text boxes provided. The **Filter** text boxes will only allow you to enter valid text which is contained in the cipher names, for example **ECDHE**. If invalid text is entered, the text box will turn red and the invalid text is deleted.

Ciphers can be dragged and dropped to/from the **Available** and **Assigned** lists as needed. Ciphers which are already assigned will appear grayed out in the **Available Ciphers** list.

Note: Progress Kemp reserves the right to change the contents of these cipher sets at any time in response to changes in industry security standards and best practices.

Clicking the **Modify Cipher Set** button in the **SSL Properties** section in the Virtual Service modify screen will bring you to the **Cipher Set Management** screen. This screen allows you to create new and modify existing custom cipher sets.

Starting with version 7.2.37, when re-encryption is enabled, the TLS version that can be negotiated between the LoadMaster and the Real Servers behind it are no longer constrained by the TLS version settings configured on the client side. All TLS versions and ciphers that are supported on the LoadMaster can be negotiated without restriction by Real Servers. In this way, the LoadMaster can, for example, provide strict security for client-side application access and still support server-side connections to legacy servers that only support specific, less secure, TLS versions, and ciphers. This is illustrated in the example below.

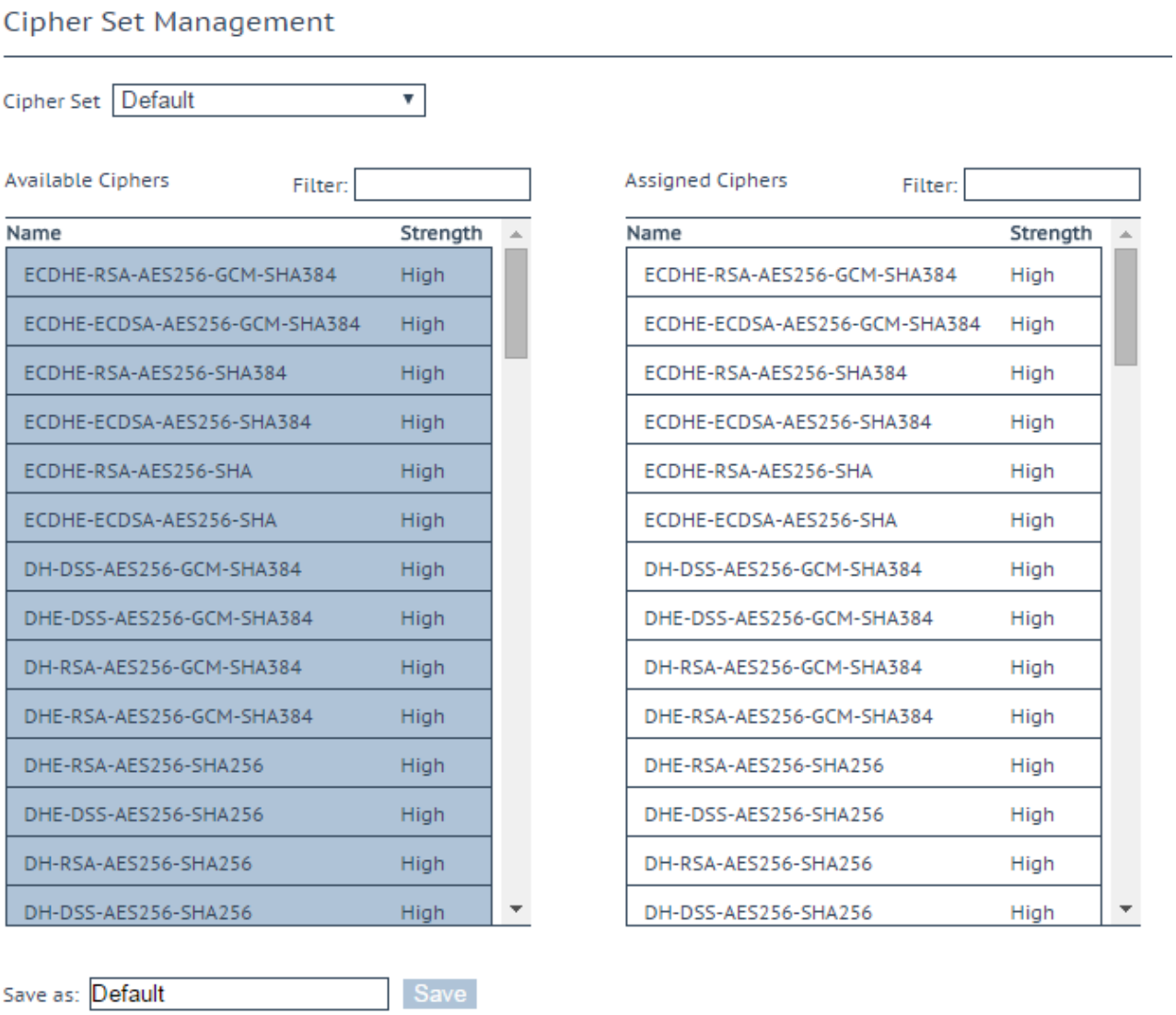


Server connections are only restricted by the configuration of the Real Servers, regardless of the TLS version selected on the client side. Each Real Server can be configured independently of the others. The LoadMaster negotiates connections according to the requirements of each Real Server.

Contents

- Cipher Set Management
- Certificate Considerations for Various Cipher Suites

Cipher Set Management



Two lists are displayed – **Available Ciphers** and **Assigned Ciphers**. These lists can be filtered by typing some text into the **Filter** text boxes provided. The **Filter** text boxes will only allow you to enter valid text which is contained in the cipher names, for example **ECDHE**. If invalid text is entered, the text box will turn red and the invalid text is deleted.

Ciphers can be dragged and dropped to/from the **Available** and **Assigned** lists as needed. Ciphers which are already assigned will appear greyed out in the **Available Ciphers** list.

Changes cannot be made to a preconfigured cipher set. However, you can start with a preconfigured cipher set – make any changes as needed and then save the cipher set with a new custom name. Enter the new name in the **Save as** text box and click the **Save** button. Custom cipher sets can be used across different Virtual Services and can be assigned as the WUI cipher set.

It is not possible to delete preconfigured cipher sets. However, custom cipher sets can be deleted by selecting the relevant custom cipher set and clicking the **Delete Cipher set** button.

Note: The RC4-MND5 SSLv3 and RC4-MND5 SSLv3 ciphers are not supported for WUI connections (this is to improve security).

Note: The RC4 ciphers are supported with (and can be assigned to) Virtual Services if needed.

Certificate Considerations for Various Cipher Suites

When you create or request SSL certificates to be used in combination with a particular cipher suite, you must be aware of the following:

- Different cipher suites require different signing algorithms to be used when creating server and client certificates.
- Some cipher suites are designed to reject self-signed certificates, as an added level of security.

The following sections outline specific requirements for various cipher suites supported by the LoadMaster.

Note: This information is not specific to the LoadMaster, but to the design of the cipher suites themselves.

Contents

- DH-RSA- and DHE-RSA- Cipher Suites
- DH-DSS- and DHE-DSS- Cipher Suites
- ECDH-ECDSA- and ECDHE-ECDSA- Cipher Suites

DH-RSA- and DHE-RSA- Cipher Suites

This section applies to all ciphers with names beginning:

- DH-RSA-
- DHE-RSA-

As indicated in the names, these ciphers require RSA signing to be used in certificates. Additionally, the certificate cannot be a self-signed certificate. Therefore, when creating a Certificate Signing Request (CSR) for a certificate to be used with this cipher, ensure to specify an RSA-signed certificate.

DH-DSS- and DHE-DSS- Cipher Suites

This section applies to all ciphers with names beginning:

- DH-DSS-
- DHE-DSS-

As indicated in the names, these ciphers require DSS (also known as DSA) signing to be used in certificates. Additionally, the certificate cannot be a self-signed certificate. Therefore, when creating a CSR for a certificate to be used with this cipher, ensure to specify a DSS-signed certificate.

ECDH-ECDSA- and ECDHE-ECDSA- Cipher Suites

This section applies to all ciphers with names beginning:

- ECDH-ECDSA-
- ECDHE-ECDSA-

As implied by the names, these ciphers require an ECDSA certificate, but it can be self-signed.

For these ciphers, the following openssl command line example from a Linux system creates a self-signed certificate for testing with the proper SSL options. The second command concatenates the key and certificate into a single file for input into the LoadMaster WUI.

```
openssl ecparam -name secp521r1 -param_enc named_curve -genkey -out private-
key.pem openssl req -new -x509 -key private-key.pem -out server-pub.pem -days
730



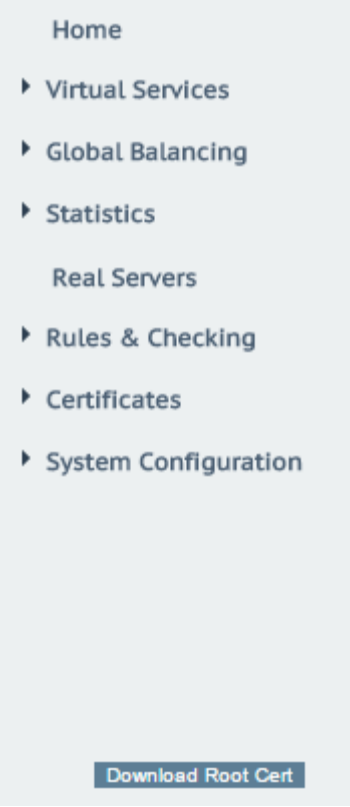
cat private-key.pem server-pub.pem > server.pem
```

Note: The **-param_enc explicit** option must not be used in the command line above, or the resulting certificate will be rejected when used to negotiate a secure connection.

If you plan to use a certificate signed by a Certificate Authority (CA), ensure to specify an ECDSA-signed certificate when creating a CSR for a certificate to be used with this cipher.

WUI Root Certificate Installation

By default the LoadMaster uses a self-signed certificate to ensure secure administrative access to the WUI. However, most modern browsers will display a warning when such a certificate is used.



In order to eliminate this warning, the LoadMaster certificate can be installed by clicking the **Download Root Cert** button in the main menu on the **Home** page, when you first access the WUI in a browser.

Note: If this button is not visible, go to the WUI **Home** and refresh the page.

This will download the certificate file that can be installed on the browser so that the security warning can be avoided.

OCSP Configuration

A Common Access Card (CAC) is a smart card used for identification of active-duty military personnel, selected reserve, US Department of Defence (DoD) civilian employees and eligible contractor personnel. In addition to providing physical access to buildings and protected areas, it also allows access to DoD computer networks and systems satisfying two-factor authentication, digital security and data encryption. It leverages a Public Key Infrastructure (PKI) Security Certificate to verify a cardholder's identity prior to allowing access to protected resources.

The Edge Security Pack (ESP) feature of the LoadMaster supports integration with DoD environments, leveraging CAC authentication and Active Directory application infrastructures. The LoadMaster acts on behalf of clients presenting X.509 certificates using CAC and becomes the authenticated Kerberos client for services.

The request for and presentation of the client certificate happens during initial SSL session establishment. There are two core elements to the process of a user gaining access to an application with CAC:

- Authentication – occurs during SSL session establishment and entails:
- Verifying the certificate date
- Verifying revocation status using Online Certificate Status Protocol (OCSP)
- Verifying the full chain to the Certificate Authority (CA)
- Authorization – occurs after SSL session establishment and the matching of the certificate Subject Alternative Name (SAN) against the User Principal Name (UPN) of the appropriate principal in Active Directory.

For each certificate, it is possible to embed the URL of the OCSP server for the CA that generated it (Authority Information Access (AIA)). So you can have a different OCSP server for each certificate. The server configured on the LoadMaster is only for the cases where the user has not specified the OCSP server in the certificate, that is, the last resort server.

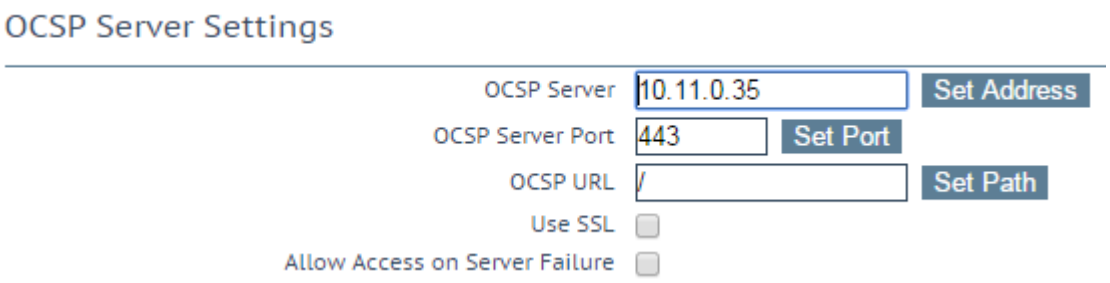
For more information, refer to the **DoD Common Access Card (CAC) Authentication Feature Description** document on the Documentation page.

Contents

- OCSP Server Settings

OCSP Server Settings

The OCSP server settings can be set in the LoadMaster WUI in **Certificates & Security > OCSP Configuration**.



OCSP Server

The address of the OCSP server.

OCSP Server Port

The port of the OCSP server.

OCSP URL

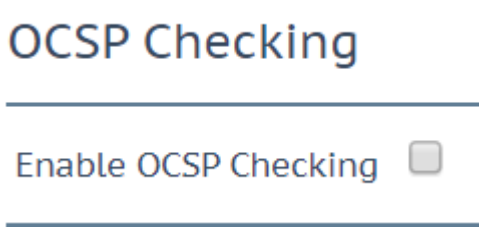
The URL to access on the OCSP server.

Use SSL

Select this to use SSL to connect to the OCSP server.

Allow Access on Server Failure

Treat an OCSP server connection failure or timeout as if the OCSP server had returned a valid response, that is, treat the client certificate as valid.



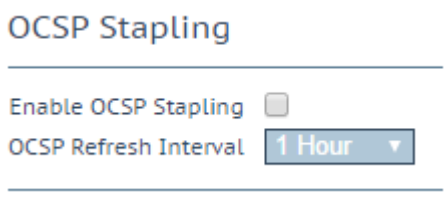
OCSP Checking

The **Enable OCSP Checking** UI control (and associated API) are all that is required in order to enable OCSP checking for outbound management connections that use certificate authentication (e.g., LDAP and remote logging).

- If the **OCSP Server/Port/URL** options are not set, all OCSP checking depends on the OCSP server setting in the AIA information from the certificate to be validated and this information is optional. If this information is not present or is invalid, no checking will be performed.
- If the **OCSP Server/Port/URL** options are set, then any certificate that does not have an OCSP server set in the AIA section will be checked using the provided OCSP server details.
- If both the certificate and the **OCSP Server/Port/URL** are set with the OCSP server address details, then only the information available in the certificate will be used to validate the certificate. If the details provided for OCSP server in the certificate are invalid, the OCSP checking will not switch to the LoadMaster OCSP server settings to validate the certificate.

The behavior with respect to the OCSP Server/Port/URL settings also applies to OCSP checking of server certificate chains.

It should also be noted that OCSP checking for real server connections is not enabled by the above control. Real server OCSP certificate checks are enabled by the **Force Real Server Certificate** Checking option.



Enable OCSP Stapling

If the **Enable OCSP Stapling** check box is enabled, the LoadMaster verifies certificates for all external connections originated by the LoadMaster (except for re-encrypted connections to the Real Servers). Select this check box to enable the LoadMaster to respond to OCSP stapling requests. If a client connects using SSL and asks for an OCSP response, this is returned. Only Virtual Service certificates are validated. The system holds a cache of OCSP responses that are sent back to the client. This cache is maintained by the OCSP daemon. When the OCSP daemon sends a request to the server, it uses the name specified in the certificate (in the **Authority Information Access** field). If it cannot resolve this name, then it uses the default

OCSP server specified in the **OCSP Server** text box.

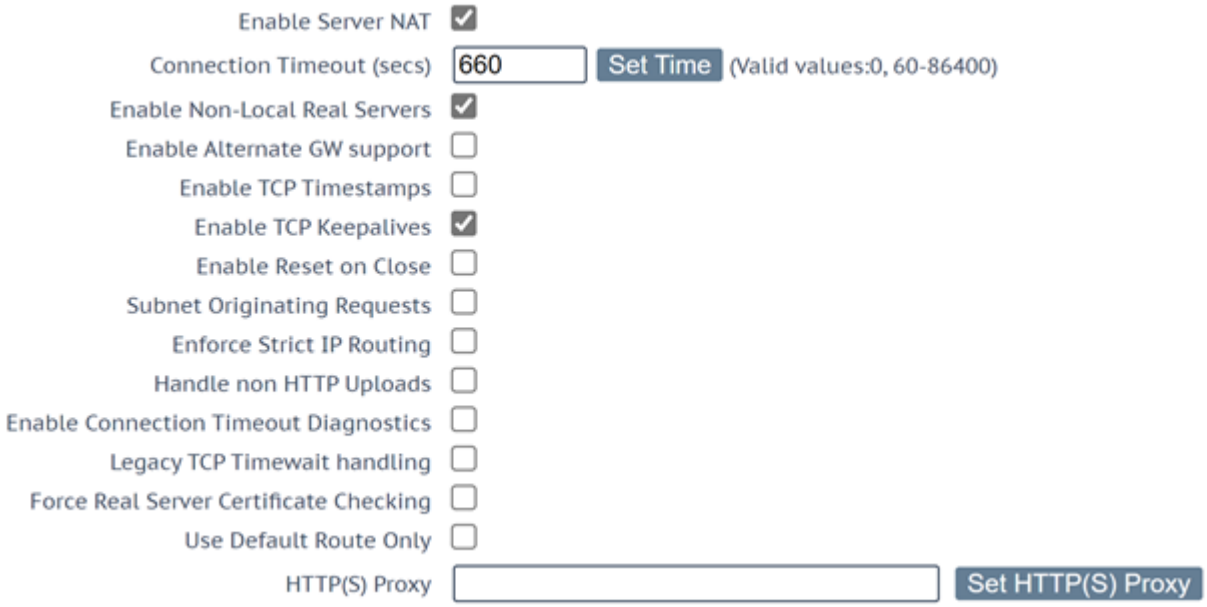
OCSP Refresh Interval

Specify how often the LoadMaster should refresh the OCSP stapling information. The OCSP daemon caches the entry for up to the amount of time specified here, after which it is refreshed. Valid values range from 1 hour (default) to 24 hours.

Setting the Diffie-Hellman Key Exchange Size

The Diffie-Helman Key Exchange Size is set to **2048 Bits** by default in the LoadMaster. This can be changed if needed. To change the Diffie-Hellman Key Exchange Size, follow the steps below:

1. In the main menu of the LoadMaster WUI, go to **Certificates & Security > SSL Options**.



2. Select the relevant option in the **Size of Diffie-Helman Key Exchange** drop-down list. Available values are:

   - 512 Bits
   - 1024 Bits
   - 2048 Bits
   - 4096 Bits

3. A reboot is required to apply the change. To reboot the LoadMaster, go to **System Configuration > System Administration > System Reboot** and click **Reboot**.

3

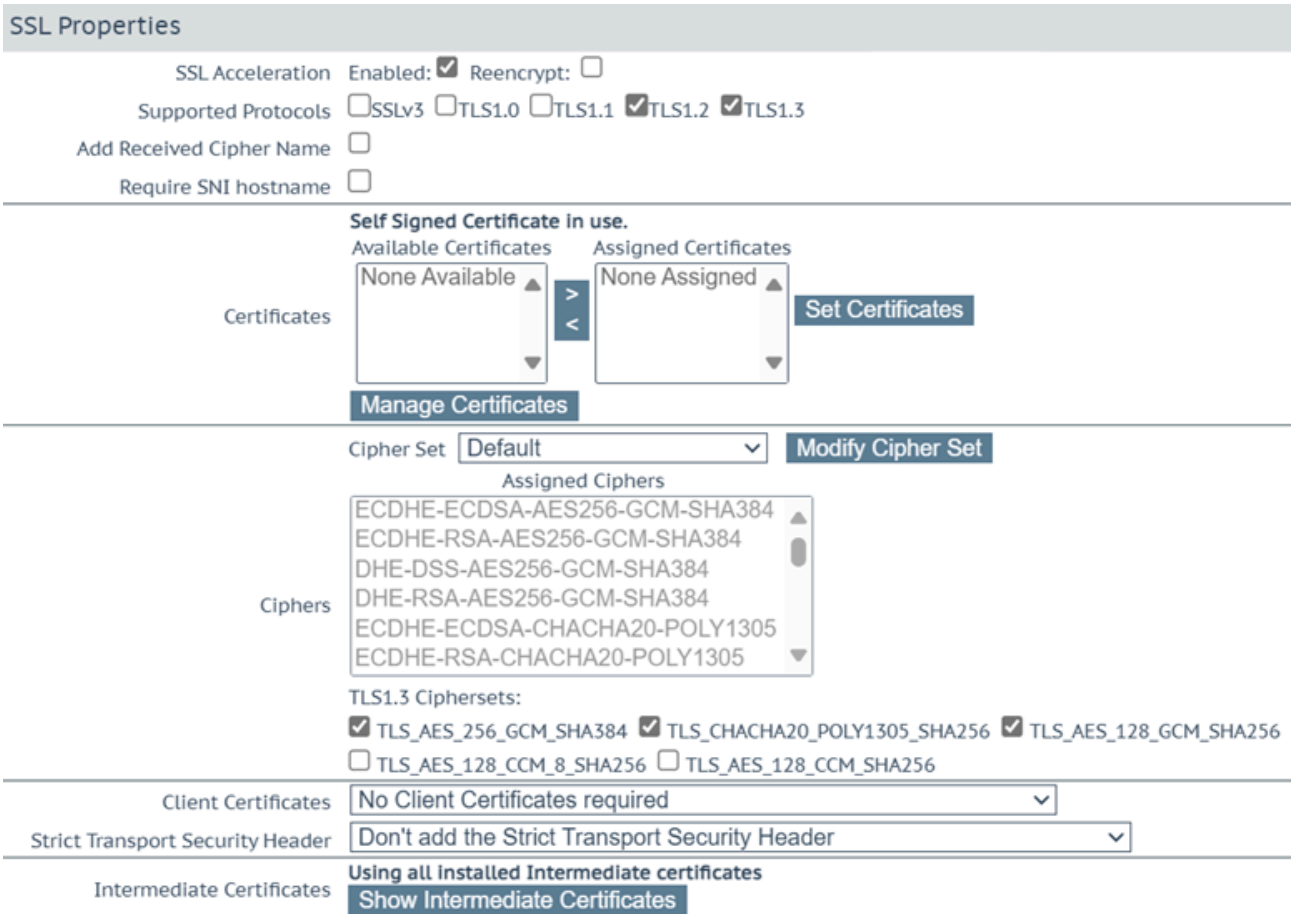
WUI Options

This section provides a description for each of the WUI options relating to SSL.

Contents

- SSL Properties
- Certificates & Security

SSL Properties



SSL Acceleration

This check box appears when the criteria for SSL Acceleration have been met. Select this check box to activate **SSL Acceleration**.

Enabled: If the **Enabled** check box is selected and there is no certificate for the Virtual Service, you are prompted to install a certificate. You can add a certificate by clicking **Manage Certificates** and importing or adding a certificate.

Reencrypt: Selecting the **Reencrypt** check box re-encrypts the SSL data stream before sending it to the Real Server.

Note: You cannot use **Extra Ports** or **Transparency** with SSL reencryption.

Reversed: Selecting this check box means that the data from the LoadMaster to the Real Server is re-encrypted. The input stream must not be encrypted, for example, the client sends HTTP port 80 traffic to the LoadMaster and the LoadMaster sends HTTPS port 443 traffic to the Real Server. This is only useful in connection with a separate Virtual Service which decrypts SSL traffic then uses this Virtual Service as a Real Service and loops data back to it. In this way, the client to Real Server data path is always encrypted on the wire.

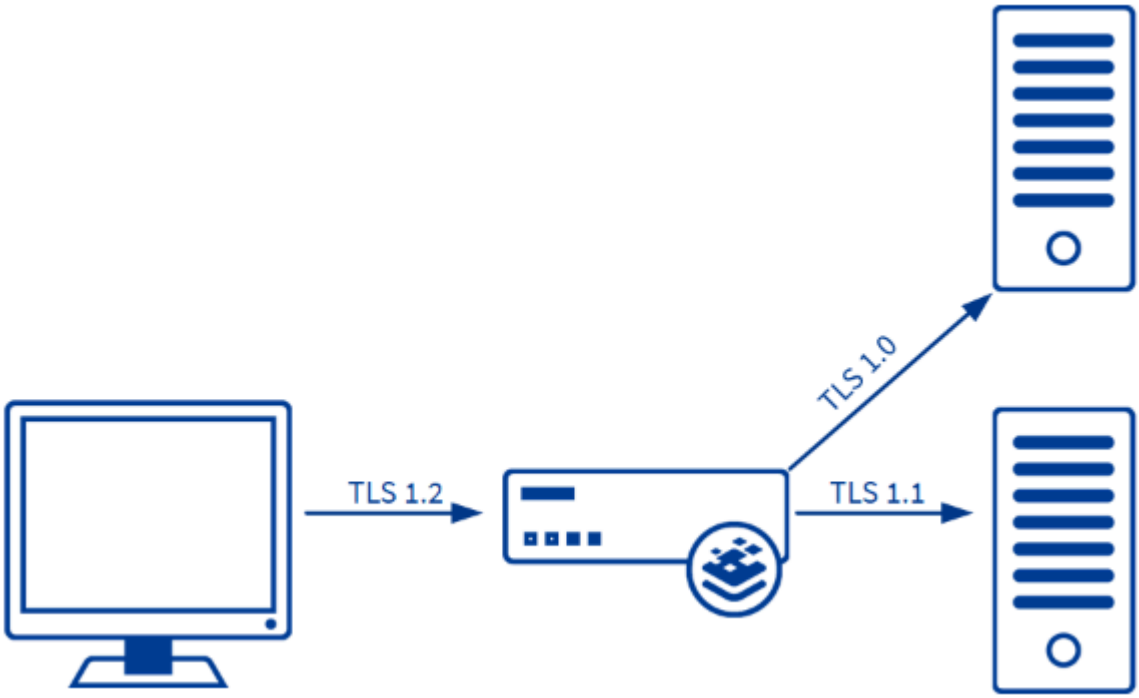
Note: The **Reversed** option is only available when the **Service Type** is set to **Generic** (**Virtual Services > View/Modify Services > Modify > Basic Properties**).

Supported Protocols

The check boxes in the **Supported Protocols** section enable you to specify which protocols are supported by the Virtual Service. By default, TLS1.1, TLS1.2, and TLS1.3 are enabled and SSLv3 and TLS1.0 are disabled.

Note: The **TLS1.3** check box will not be visible if the **OpenSSL Version** setting in **Certificates & Security > SSL Options** is set to **Use older SSL library - no TLS 1.3**.

Starting with version 7.2.37, when re-encryption is enabled, the TLS version that can be negotiated between the LoadMaster and the Real Servers behind it are no longer constrained by the TLS version settings configured on the client side. All TLS versions and ciphers that are supported on the LoadMaster can be negotiated without restriction by Real Servers. In this way, the LoadMaster can, for example, provide strict security for client-side application access and still support server-side connections to legacy servers that only support specific, less secure, TLS versions, and ciphers. This is illustrated in the example below.



Server connections are only restricted by the configuration of the Real Servers, regardless of the TLS version selected on the client side. Each Real Server can be configured independently of the others. The LoadMaster negotiates connections according to the requirements of each Real Server.

Add Received Cipher Name

In LoadMaster version 7.2.52 and above, a new check box called **Add Received Cipher Name** was added. This option is disabled by default. When this option is enabled, the LoadMaster adds X-SSL headers containing client SSL information such as TLS version, TLS cipher, client certificate serial number, and SNI host as described in below table.

The information contained in these headers can be used in content rules by referencing the appropriate header name in the rule (see the table below). This allows you to make load balancing decisions based on, for example, the cipher used.

This information can also be useful, for example, as you maintain cipher sets over time; it allows you to see which ciphers are being used and can help you plan what ciphers to change or delete in the cipher sets. The **Add Received Cipher Name** check box must be enabled to use the headers in the table below in content rules.

Header	Description	Example Value
X-SSL-Cipher	The cipher used.	X-SSL-Cipher: ECDHE-RSA-AES256-GCM-SHA384
X-SSL-Protocol	The SSL protocol version used.	X-SSL-Protocol: TLSv1.2
X-SSL-Serialid	The Virtual Service certificate serial number.	X-SSL-Serialid: 4900000006A2ABDC165ACEAD55000000000006
X-SSL-ClientSerialid	The client certificate serial number.	X-SSL-ClientSerialid: 490000005D6898F3C7E590536100010000005D
X-SSL-SNIHost	The value of the received SNI name.	X-SSL-SNIHost: sni.test.com

Require SNI hostname

If require Server Name Indication (SNI) is selected, the hostname is always required to be sent in the TLS client hello message.

When **Require SNI hostname** is disabled, the first certificate is used if a host header match is not found.

When **Require SNI hostname** is enabled, a certificate with a matching common name must be found, otherwise an SSL error is yielded. Wildcard certificates are also supported with SNI.

Note: When using a Subject Alternative Name (SAN) certificate, alternate source names are not matched against the host header.

Note: Wildcard certificates are supported but note that the root domain name is not matched, as per RFC 2459. Only anything to the left of the dot is matched. Additional certificates must be added to match the root domain names. For example, www.kemptechnologies.com is matched until a wildcard of *.kemptechnologies.com. Kemptechnologies.com is not matched.

Note: To send SNI host information in HTTPS health checks, enable **Use HTTP/1.1** in the **Real Servers** section of the relevant Virtual Service(s) and specify a host header. If this is not set, the IP address of the Real Server is used.

Pass through SNI hostname

In LoadMaster firmware version 7.2.52 and above, when this option is enabled and when re-encrypting, the received SNI hostname is passed through as the SNI to be used to connect to the Real Server. If the Virtual Server has a **Reencryption SNI Hostname** set, this overrides the received SNI.

Note: This field is only visible when SSL re-encryption is enabled.

Certificates

Available certificates are listed in the **Available Certificates** select list on the left. To assign or unassign a certificate, select it and click the right or left arrow button. Then click **Set Certificates**. Multiple certificates can be selected by holding **Ctrl** on your keyboard and clicking each required certificate.

Note: There is a limit of 8171 characters when assigning certificates to a Virtual Service using the WUI.

Note: A Virtual Service can be configured using both RSA and ECC certificates. However, if an RSA and an ECC certificate have the same common name, for example, progress.com, the first certificate is preferred. If the ECC certificate is first in the list, and a client does not have an ECC cipher, the connection fails. Conversely, if the RSA certificate is first in the list, and a client does not have an RSA cipher, the connection fails.

Note: The total number of certificates that you can add to a Virtual Service is 256, but this number may be further limited by the size of the certificate file names used. In LMOS Version 7.2.47 and later releases, the number of characters in each certificate file name and extension (not counting the period between them), plus all spaces used to separate multiple file names, must add up to 8176 characters or less (in earlier releases, the limitation is 1023 characters.)

Clicking **Manage Certificates** brings you to the SSL Certificates screen.

CAUTION: If you click **Manage Certificates** and replace a certificate in the current list, the replaced certificate moves to the bottom of the certificate list upon returning to the Virtual Service page. If the replaced certificate should be higher in the list, you can select all the certificates in the **Assigned Certificates** box on the right, move them back to the **Available Certificates** box on the left, and then re-add them in the required order.

If you add a certificate to the LoadMaster in version 7.2.51 or later (or in 7.2.48.3 LTS or a later LTS version) and then downgrade to 7.2.50 or an earlier version (or 7.2.48.2 LTS or an earlier version) - the certificate will not work. To work around this, create a backup of all SSL certificates before downgrading and then restore the certificates after downgrading (**Certificates & Security > Backup/Restore Certs**). If you forget to take the backup before downgrading: upgrade the firmware again, take the certificate backup, downgrade, and then restore the certificate backup.

Reencryption Client Certificate

With SSL connections, the LoadMaster gets a certificate from the client and also gets a certificate from the server. The LoadMaster transcribes the client certificate in a header and sends the data to the server. The server still expects a certificate. This is why it is preferable to install a pre-authenticated certificate in the LoadMaster.

Reencryption SNI Hostname

In LoadMaster firmware version 7.2.52 and above, it is possible to set a Reencryption SNI Hostname at the SubVS level. If this is set in a SubVS, this overrides the parent Virtual Service value and/or the received SNI value.

Note: This field is only visible when SSL re-encryption is enabled.

Cipher Set

A cipher is an algorithm for performing encryption or decryption.

Each Virtual Service (which has **SSL Acceleration** enabled) has a cipher set assigned to it. This can either be one of the system-defined cipher sets or a user-customized cipher set. You can select system-defined cipher sets to quickly and easily select and apply the relevant ciphers. You can create and modify custom cipher sets by clicking **Modify Cipher Set**.

Note: The selection of TLS1.2 and below protocols ciphers become unavailable when only TLS1.3 protocol is selected.

Ciphers

The **Ciphers** list is read only and displays a list of the currently assigned ciphers. Clicking **Modify Cipher Set** brings you to the **Cipher Set Management** screen. This screen allows you to create new, and modify existing custom cipher sets.

TLS1.3 Cipher Sets

Select the cipher sets for the TLS1.3 protocol to be allowed using any combination of supported ciphers over an SSL-enabled Virtual Service. By default, the following three cipher sets are enabled:

- TLS_AES_256_GCM_SHA384
- TLS_CHACHA20_POLY1305_SHA256
- TLS_AES_128_GCM_SHA256

Note: It is not possible to disable all ciphersets.

Note: The TLS1.3 cipher sets only become available when the **TLS1.3** protocol is enabled.

Note: TLS1.3 ciphers are always available regardless of whether the selected cipher set contains any TLS1.3 ciphers, which is how the OpenSSL libraries behave. TLS1.3 ciphers can only be removed from offered ciphers by disabling the TLS1.3 protocol (which is not recommended).

Client Certificates

- **No Client Certificates required:** enables the LoadMaster to accept HTTPS requests from any client. This is the recommended option.

By default the LoadMaster accepts HTTPS requests from any client. Selecting any of the other values below requires all clients to present a valid client certificate. In addition, the LoadMaster also passes information about the certificate to the application.

Note: You should not change this option from the default of **No Client Certificates required**. Only change from the default option if you are sure that all clients that access this service have valid client certificates.

- **Client Certificates required:** requires that all clients forwarding a HTTPS request must present a valid client certificate.
- **Client Certificates and add Headers**: requires that all clients forwarding a HTTPS request must present

a valid client certificate. The LoadMaster also passes information about the certificate to the application by adding headers. When a client certificate is used, the **X-SSL-ClientSerialid** header is set.

- The below options send the certificate in its original raw form. The different options let you specify the format that you want to send the certificate in:
  - Client Certificates and pass DER through as SSL-CLIENT-CERT
  - Client Certificates and pass DER through as X-CLIENT-CERT
  - Client Certificates and pass PEM through as SSL-CLIENT-CERT
  - Client Certificates and pass PEM through as X-CLIENT-CERT

If a Virtual Service:

- Has **SSL Acceleration** enabled, and
- Any of the client certificate required options with "pass through as SSL-CLIENT-CERT/X-CLIENT-CERT" is selected in the **Client Certificates** drop-down list, and
- A **Delete Header** rule is applied to that Virtual Service to delete the SSL/X-CLIENT-CERT header field, then

  The **Delete Header** content rule preserves the LoadMaster inserted client certificate header fields and removes any header with that name passed in by the client.

Verify Client using OCSP

Verify (using Online Certificate Status Protocol (OCSP)) that the client certificate is valid.

Note: This option is only visible when ESP is enabled.

Strict Transport Security Header

Enable this option to add the Strict-Transport-Security header to all LoadMaster-generated messages (ESP and error messages). The options in this drop-down list are as follows:

- Don't add the Strict Transport Security Header
- Add the Strict Transport Security Header - no subdomains
- Add the Strict Transport Security Header - include subdomains
- Add the Strict Transport Security Header - no subdomains + preload
- Add the Strict Transport Security Header - include subdomains + preload

Intermediate Certificates

Prior to the **Intermediate Certificates** field being added to the **SSL Properties** section, there was no ability to assign intermediate or root certificates to a Virtual Service. The Certificate Authority (CA) for client certificates was kept in the global certificate store, so the following could occur:

- Client certificates from two different CAs are installed on the LoadMaster
- Client A presents a certificate issued from CA 1 and as a network administrator, you only want them to be able to access Virtual Service 1.

- Client B presents a certificate issued from CA 2 and as a network administrator, you only want them to be able to access Virtual Service 2.
- Because both client certificates are validated against the global LoadMaster trust store, client A is also allowed access to Virtual Service 2 and client B is also allowed access to Virtual Service 1.

The **Intermediate Certificates** field allows you to assign intermediate and root certificates to specific Virtual Services. This provides the ability to restrict access. It also enables control on what client certificates are eligible to be used when connecting to a service which is useful in environments with multiple client certificates signed by multiple authorities. For example, when this is configured correctly for the scenario above - Client A will only have access to Virtual Service 1 and Client B will only have access to Virtual Service 2.

To configure this, follow the steps below:

1. Upload the relevant certificates.
2. Then in the LoadMaster User Interface (UI), go to **Virtual Services > View/Modify Services**.
3. Click **Modify** on the relevant Virtual Service.
4. Expand the **SSL Properties** section.
5. Click **Show Intermediate Certificates**.
6. Select the relevant certificates from the boxes and click the arrows to remove/assign them from/to the Virtual Service.
7. Then, click **Set Intermediate Certificates**.

Note: It is not possible to unassign all certificates from the Virtual Service. If you do not want client certificates to be required - select **No Client Certificates required** in the **Client Certificates** drop-down list.

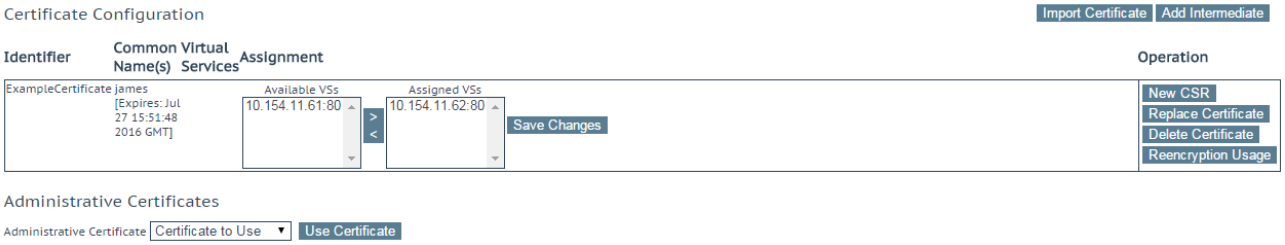
Certificates & Security

The sections below describe the various screens in the **Certificates & Security** section of the LoadMaster WUI.

Contents

- SSL Certificates
- Intermediate Certificates
- ACME Certificates
- Generate CSR (Certificate Signing Request)
- Backup/Restore Certs
- Cipher Sets
- Remote Access
- OCSP Configuration

SSL Certificates



Shown above is the **Manage Certificates** screen. Details about the various options on this screen are below:

Import Certificate – to import the certificate with a chosen filename.

Add Intermediate – refer to the Intermediate Certificates section for further information.

Identifier – is the name given to the certificate at the time it was created.

Common Name(s) – is the FQDN (Fully Qualified Domain Name) for the site.

Virtual Services – the Virtual Service with which the certificate is associated.

Assignment – lists of available and assigned Virtual Services

Operations –

- **New CSR** – generates a new Certificate Signing Request (CSR) based on the current certificate.

Note: If the certificate has Subject Alternative Names (SANs), generating a CSR in this way will not add the SANs. Instead, generate the CSR manually. For further information on this, refer to the Generate CSR (Certificate Signing Request) section.

- **Replace Certificate** – updates or replaces the certificate stored in this file.
- **Delete Certificate** – deletes the relevant certificate.

Note: You cannot delete or replace Let's Encrypt/DigiCert certificates from the **SSL Certificates** screen. You can only delete or replace Let's Encrypt/DigiCert certificates from **Certificates & Security > ACME Certificates**. The **Replace Certificate** and **Delete Certificate** buttons are grayed out on the **SSL Certificates** screen for Let's Encrypt/DigiCert certificates.

- **Reencryption Usage** – display the Virtual Services that are using this certificate as a client certificate when re-encrypting.

Administrative Certificates – the certificate you want to use, if any, for the administrative interface.

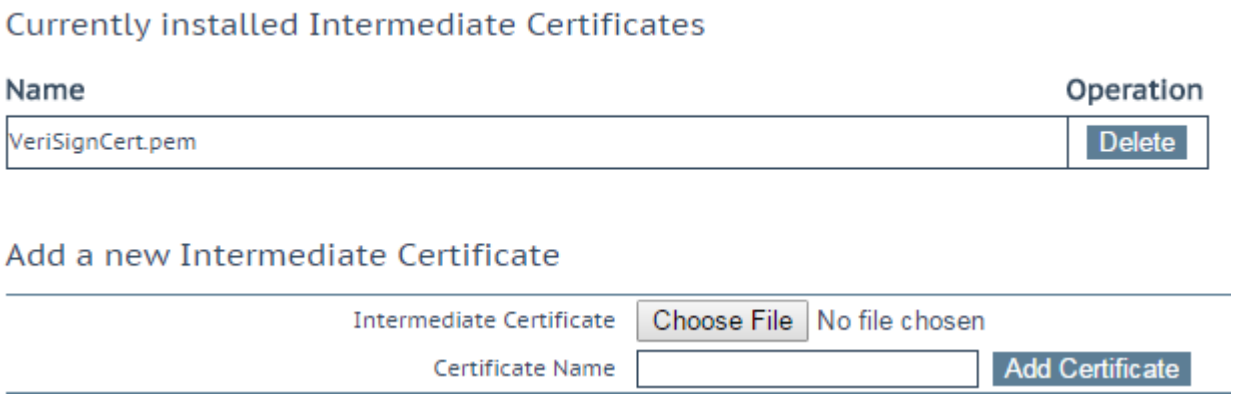
The LoadMaster supports key sizes higher than 2048 bit. However, increasing the key size reduces the SSL Transactions Per Second (TPS) performance non-linearly. That means that performance with a 4096 bit key will drop substantially (by at least a power of four) compared to a 2048 bit key. To achieve the same performance with larger keys, more powerful hardware is needed.

However, as indicated by the National Institute of Standards and Technology (NIST); 2048 bit keys have a

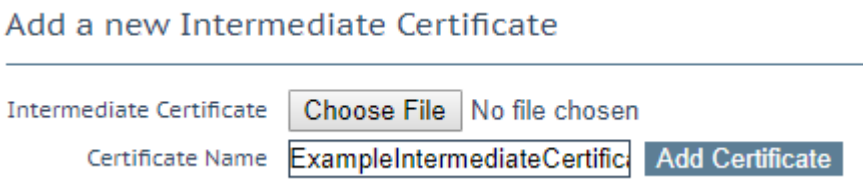
security lifetime until 2030:

"In many cases, a variety of key sizes may be available for an algorithm. For some of the algorithms (e.g., public key algorithms, such as RSA), the use of larger key sizes than are required may impact operations, e.g., larger keys may take longer to generate or longer to process the data. However, the use of key sizes that are too small may not provide adequate security."

Intermediate Certificates



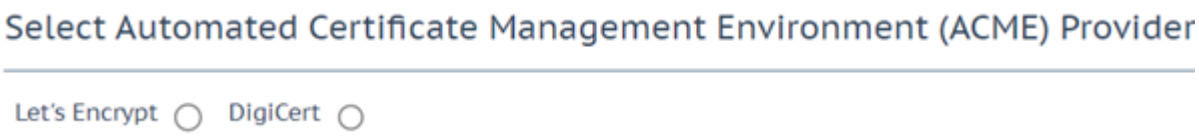
This screen shows a list of the installed intermediate certificates and the name assigned to them.



If you already have a certificate, or you have received one from a CSR, you can install the certificate by clicking the **Choose File** button. Navigate to and select the certificate and then enter the desired **Certificate Name**. The name can only contain alpha characters with a maximum of 32 characters.

Uploading several consecutive intermediate certificates within a single piece of text, as practiced by some certificate vendors such as GoDaddy, is allowed. The uploaded file is split into the individual certificates.

ACME Certificates



The LoadMaster provides an option of two Automated Certificate Management Environment (ACME) providers:

- Let's Encrypt

- DigiCert

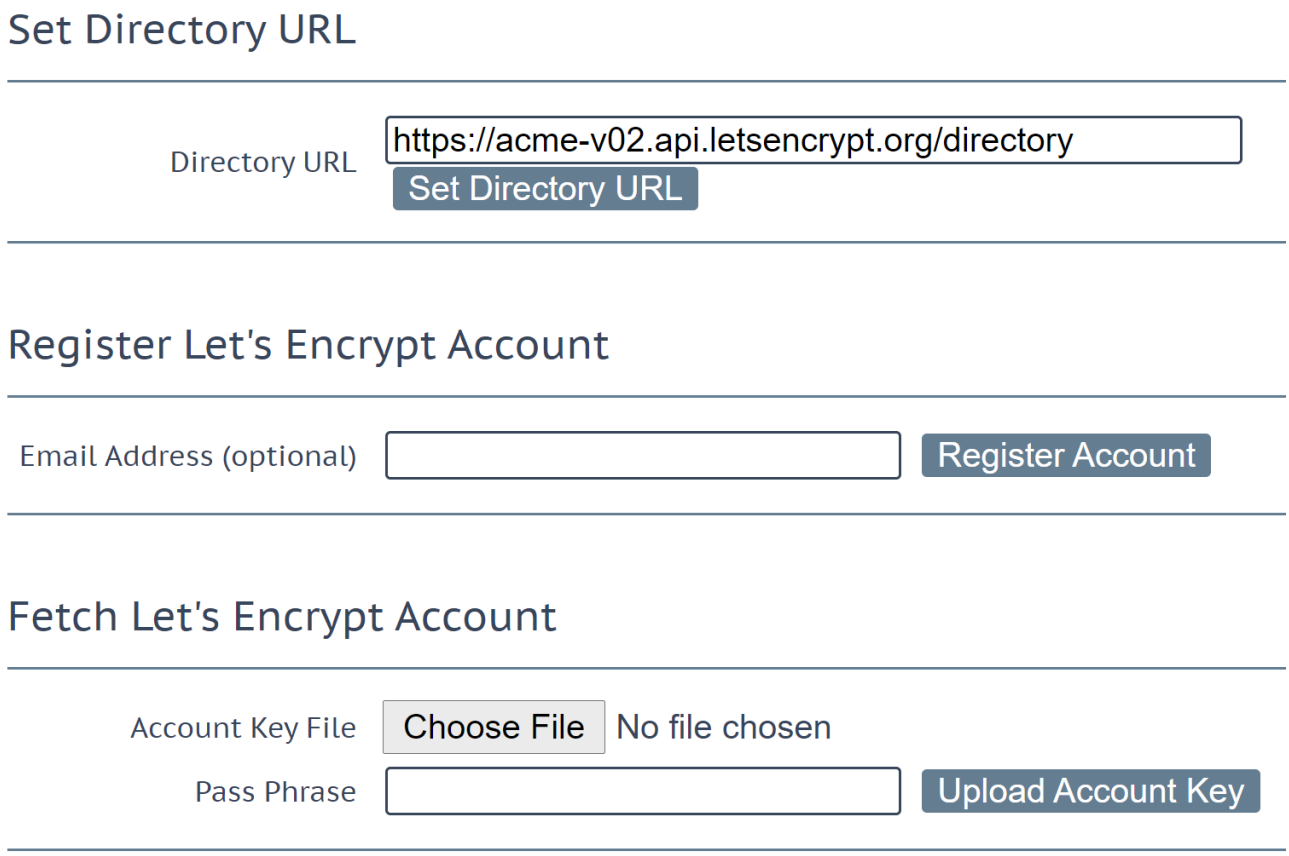
Refer to the relevant section below for further details.

For detailed information related to DigiCert, refer to the DigiCert Feature Description.

Contents

- Let's Encrypt Certificates
- DigiCert Certificates

Let's Encrypt Certificates



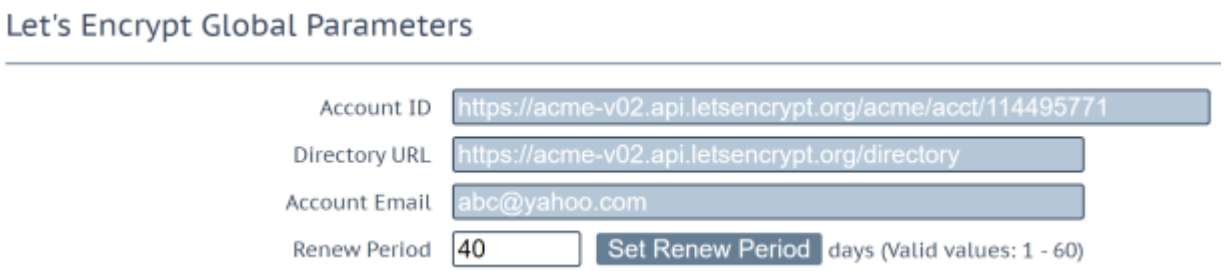
Directory URL: Enter the URL of the Automated Certificate Management Environment (ACME) server in the **Directory URL** field and click **Set Directory URL**. The default URL is the Let's Encrypt production ACME server: **https://acme-v02.api.letsencrypt.org/directory**. This can be changed as needed. The LoadMaster supports API version 2 of the ACME protocol.

Email Address (optional): You can register for Let's Encrypt account by optionally entering your **Email Address** and clicking **Register Account**.

Account Key File: If you already have an existing Let's Encrypt account, you can upload the **Account Key File** by clicking the **Choose File** button. Navigate to and select the key file. You can retrieve the account key file from other ACME clients that you registered the account with (like Certbot).

Pass Phrase: Enter the passphrase associated with the certificate and click **Upload Account Key** to link to your existing account.

Once you have successfully registered or linked to your existing Let's Encrypt account, the **Manage Let's Encrypt Certificates** screen appears.



Renew Period

Let's Encrypt certificates are valid for 90 days. The **Renew Period** value specifies how many days in advance of certificate expiry you would like the certificate to be renewed. The **Renew Period** is an account-wide setting. Per-certificate renewal periods are not supported at this time.

The **Renew Period** is set to 30 days by default. Let's Encrypt recommends renewing certificates 30 days before expiry. Valid values for the **Renew Period** field range from 1 to 60 (days). The old certificates are replaced and assigned to the HTTPS Virtual Service when the renewal is successful.

For more information and instructions, refer to the **Let's Encrypt Feature Description** on the Documentation page.

Request New Certificate

Click **Request New Certificate** to request a new certificate from the Let's Encrypt CA.

All fields on the **Request a New Certificate** screen are optional except for **Certificate Identifier** and **Common Name** (and you must select a Virtual Service next to the **Common Name** field).

Certificate Identifier: Enter a unique identifier. The **Certificate Identifier** value must be unique for all certificates on the LoadMaster.

Common Name: Enter the FQDN of your web server. This is case sensitive. Certificates are only issued to valid hosting domains that you have control over. Select the Virtual Service that is used for this domain. This will be used for the validation challenge to prove ownership of the domain.

Note: A HTTP/HTTPS Layer 7 Virtual Service must be already configured with the ability to add a SubVS (so it should not have any Real Servers added to the parent Virtual Service - but if there are existing SubVSs they can have Real Servers attached). For instructions on how to convert an existing Virtual Service with Real Servers attached to one with SubVSs with Real Servers attached, refer to the **Let's Encrypt Feature Description** on the Documentation page.

Note: A HTTP Redirect Virtual Service must be configured to redirect all port 80 requests to 443 because Let's Encrypt communicates on port 80 to perform the HTTP-01 challenge.

Note: All valid Virtual Services that meet the criteria are listed in the drop-down list.

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2 Letter Country Code: Optionally enter the two-letter country code. For a list of valid country codes, refer to the following page: SSL Certificate Country Codes. If using Let's Encrypt, the **2 Letter Country Code** to **Email Address** fields are truncated.

State/Province: Optionally enter the state or province to include in the certificate. Enter the full name, for example **New York** (not NY).

City: Optionally enter the city to include in the certificate.

Company: Optionally enter the name of the company to include in the certificate.

Organization: Optionally enter the department or organizational unit that should be contacted regarding this certificate.

Email Address: Optionally enter the email address of the person or organization that should be contacted regarding this certificate.

Generate Elliptic Curve Request: Optionally enable or disable this option. If this is enabled, an Elliptic Curve request is generated instead of an RSA request.

Key Size: Select the algorithm size from the drop-down list. If you are generating an Elliptic Curve (EC) request, the **Key Size** drop-down is grayed out. The default size of 256 Bits is used for EC requests. If you are generating an RSA request, you can specify the **Key Size**.

SAN/UCC Names: Enter the Subject Alternate Name (SAN). This must be a valid domain. You can specify up to 10 SANs.

For every SAN you must select a HTTP/HTTPS Layer 7 Virtual Service (you can use the same Virtual Service). For each SAN you must prove your authority to the Let's Encrypt server. A HTTP/HTTPS Virtual Service must be already configured with the ability to add a SubVS (so it should not have any Real Servers added to the parent Virtual Service - but if there are existing SubVSs they can have Real Servers attached). For instructions on how to convert an existing Virtual Service with Real Servers attached to one with SubVSs with Real Servers attached, refer to the **Let's Encrypt Feature Description** on the Documentation page.

Request Certificate: A list of issued certificates and related details are displayed at the bottom of the **Let's Encrypt Certs** screen. The **HTTP Challenge VS(s)** column lists the Virtual Service (or Services) that were used for the HTTP challenge. These are not the Virtual Services that the certificates are assigned to.

Once the certificate is issued successfully, it will be listed in **Certificates & Security > SSL Certificates**. You can then assign it to any HTTPS Virtual Service or use it as an administrative certificate.

Note: When manually assigning a new certificate to a Virtual Service for the first time, the Virtual Service will restart so we recommend doing this outside of working hours.

When Let's Encrypt certificates are renewed, the Virtual Services that have the certificate assigned will be automatically updated with the renewed certificate.

Note: Automatic renewal and updating of certificates is seamless and does not affect Virtual Service traffic.

Certificates are automatically renewed at the number of days specified in the **Renew Period** before the expiry date of each certificate. You can manually renew the certificate by clicking **Renew Certificate**.

You can also delete a certificate associated with the domain by clicking **Delete Certificate**.

Note: If the certificate is used (for example if it is assigned in a Virtual Service or used as an administrative certificate) the **Delete Certificate** button is grayed out.

You cannot delete or replace Let's Encrypt certificates from the **SSL Certificates** screen. You can only delete or replace Let's Encrypt certificates from the **Let's Encrypt Certs** screen. The **Replace Certificate** and **Delete Certificate** buttons are grayed out on the **SSL Certificates** screen for Let's Encrypt certificates.

DigiCert Certificates

In the **DigiCert Account Settings** section, you can configure the following options:

- **Directory URL:** Set the directory URL for the Certificate Authority (CA) environment.
- **Key ID:** Set an account **Key ID** used for identification on the DigiCert account.
- **HMAC Key:** Set the Hash-Based Message Authentication Code (HMAC) key used to authenticate to the DigiCert account.

After setting each of the options, click **Save Account Settings**.

Once you have successfully saved your account settings, the **Manage DigiCert Certificates** screen appears.

Renew Period

The **Renew Period** value specifies how many days in advance of certificate expiry you would like the certificate to be renewed. The **Renew Period** is an account-wide setting. Per-certificate renewal periods are not supported at this time.

Delete ACME Configuration Parameters

Delete the ACME configuration parameters (which allows you to configure either the Let's Encrypt or DigiCert configuration from the start).

Note: You can only delete the configuration if there are no ACME certificates.

Request New Certificate

Click **Request New Certificate** to request a new certificate from the DigiCert CA.

All fields on the **Request a New Certificate** screen are optional except for **Certificate Identifier** and **Common Name** (and you must select a Virtual Service next to the **Common Name** field).

Certificate Identifier: Enter a unique identifier. The **Certificate Identifier** value must be unique for all certificates on the LoadMaster.

Common Name: Enter the FQDN of your web server. This is case sensitive. Certificates are only issued to valid hosting domains that you have control over. Select the Virtual Service that is used for this domain. This will be used for the validation challenge to prove ownership of the domain.

Note: A HTTP/HTTPS Layer 7 Virtual Service must be already configured with the ability to add a SubVS

(so it should not have any Real Servers added to the parent Virtual Service - but if there are existing SubVSs they can have Real Servers attached). For instructions on how to convert an existing Virtual Service with Real Servers attached to one with SubVSs with Real Servers attached, refer to the **DigiCert Feature Description** on the Documentation page.

Note: A HTTP Redirect Virtual Service must be configured to redirect all port 80 requests to 443 because DigiCert communicates on port 80 to perform the HTTP-01 challenge.

Note: All valid Virtual Services that meet the criteria are listed in the drop-down list.

2 Letter Country Code: Optionally enter the two-letter country code. For a list of valid country codes, refer to the following page: SSL Certificate Country Codes. If using DigiCert, the **2 Letter Country Code** to **Email Address** fields are truncated.

State/Province: Optionally enter the state or province to include in the certificate. Enter the full name, for example **New York** (not NY).

City: Optionally enter the city to include in the certificate.

Company: Optionally enter the name of the company to include in the certificate.

Organization: Optionally enter the department or organizational unit that should be contacted regarding this certificate.

Email Address: Optionally enter the email address of the person or organization that should be contacted regarding this certificate.

Generate Elliptic Curve Request: Optionally enable or disable this option. If this is enabled, an Elliptic Curve request is generated instead of an RSA request.

Key Size: Select the algorithm size from the drop-down list. If you are generating an Elliptic Curve (EC) request, the **Key Size** drop-down is grayed out. The default size of 256 Bits is used for EC requests. If you are generating an RSA request, you can specify the **Key Size**.

SAN/UCC Names: Enter the Subject Alternate Name (SAN). This must be a valid domain. You can specify up to 10 SANs.

For every SAN you must select a HTTP/HTTPS Layer 7 Virtual Service (you can use the same Virtual Service). For each SAN you must prove your authority to the DigiCert server. A HTTP/HTTPS Virtual Service must be already configured with the ability to add a SubVS (so it should not have any Real Servers added to the parent Virtual Service - but if there are existing SubVSs they can have Real Servers attached). For instructions on how to convert an existing Virtual Service with Real Servers attached to one with SubVSs with Real Servers attached, refer to the **DigiCert Feature Description** on the Documentation page.

Request Certificate: When you are finished setting the relevant fields, click **Request Certificate** to create a new certificate request using the specified data.

A list of issued certificates and related details are displayed at the bottom of the **Manage DigiCert Certificates** screen. The **HTTP Challenge VS(s)** column lists the Virtual Service (or Services) that were used for the HTTP challenge. These are not the Virtual Services that the certificates are assigned to.

Once the certificate is issued successfully, it will be listed in **Certificates & Security > SSL Certificates**. You can then assign it to any HTTPS Virtual Service or use it as an administrative certificate.

Note: When manually assigning a new certificate to a Virtual Service for the first time, the Virtual Service will restart so we recommend doing this outside of working hours.

When DigiCert certificates are renewed, the Virtual Services that have the certificate assigned will be automatically updated with the renewed certificate.

Note: Automatic renewal and updating of certificates is seamless and does not affect Virtual Service traffic.

Certificates are automatically renewed at the number of days specified in the **Renew Period** before the expiry date of each certificate. You can manually renew the certificate by clicking **Renew Certificate**.

You can also delete a certificate associated with the domain by clicking **Delete Certificate**.

Note: If the certificate is used (for example if it is assigned in a Virtual Service or used as an administrative certificate) the **Delete Certificate** button is grayed out.

You cannot delete or replace DigiCert certificates from the **SSL Certificates** screen. You can only delete or replace DigiCert certificates from the **Manage DigiCert Certificates** screen (**Certificates & Security > ACME Certificates**). The **Replace Certificate** and **Delete Certificate** buttons are grayed out on the **SSL Certificates** screen for DigiCert certificates.

Generate CSR (Certificate Signing Request)

If you do not have a certificate, you may complete the Certificate Signing Request (CSR) form and click the **Create CSR** button. CSRs generated by the LoadMaster use SHA256.

Note: If **Self-Signed Certificate Handling** is set to **EC certs with an EC signature** (in **Certificates & Security > Remote Access**), CSR generation is restricted to the administrative (**bal**) user only. If **Self-Signed Certificate Handling** is set to a different value, all users (regardless of their permissions) can generate CSRs.



2 Letter Country Code (ex. US)

The 2 letter country code that should be included in the certificate, for example **US** should be entered for the United States.

State/Province (Entire Name – New York, not NY)

The state which should be included in the certificate. Enter the full name here, for example **New York**, not NY.

City

The name of the city that should be included in the certificate.

Company

The name of the company which should be included in the certificate.

Organization (e.g., Marketing,Finance,Sales)

The department or organizational unit that should be included in the certificate.

Common Name

The Fully Qualified Domain Name (FQDN) for your web server.

Email Address

The email address of the responsible person or organization that should be contacted regarding this certificate.

SAN/UCC Names

A space-separated list of alternate names.

Generate Elliptical Curve Request

By default, CSRs generated by the LoadMaster request an RSA-encrypted key. If you enable the **Generate Elliptical Curve Request** option, the LoadMaster instead requests an EC (Elliptical Curve) key. Smaller EC key sizes generally provide the same cryptographic strength as much larger RSA key sizes. EC keys are becoming increasingly common because of both the reduced storage footprint in addition to reduced processing resources required.

Display Private Key

This new option (introduced in LoadMaster firmware version 7.2.52 and LTS version 7.2.48.3) appears only when the **Certificates & Security > Remote Access > Self-Signed Certificate Handling** option is set to **EC certs with an EC signature** which means that an elliptical curve cipher is used for both the certificate and the digital signature.

Once the above option is selected, a **Display Private Key** check box appears on the **Certificates & Security > Generate CSR** WUI page.

- When **Display Private Key** is disabled (the default), the private key is not displayed in the WUI after the CSR is created. The unsigned CSR is downloaded by the user as in previous releases. Once it is signed by a Certificate Authority, the user uploads the signed certificate to the LoadMaster - the difference from previous releases being that the user does not have to also upload the private key, since LoadMaster maintains it internally when **Display Private Key** is disabled. If the saved private key matches the new certificate, the certificate gets imported and the saved private key is deleted. The stored private key is not encrypted but there is no access to it from the outside and it cannot be seen or displayed.
- When **Display Private Key** is enabled, the LoadMaster behaves as in previous releases: the private key is displayed to the user and must be uploaded to LoadMaster along with the private key.

There is only one private key per machine and it is not shared between High Availability (HA) pairs. This means the newly-generated certificate must be installed on the machine that the CSR was generated on.

Alter clicking the **Create CSR** button, the following screen appears:

The following is your 2048 bit *unsigned* certificate request. Copy the following, in its entirety, and send it to your trusted certificate authority

```
-----BEGIN CERTIFICATE REQUEST-----
MIIC9zCCAd8CAQAwgbExCzAJBgNVBAYTAlVTMREwDwYDVQQIEwhOZXcgWW9yazER
MA8GA1UEBxMITmV3IFlvcmsxGjAYBgNVBAoTEUtFTVAgVGVjaG5vbG9naWVzMR0w
GwYDVQQLExRLbm93bGVkZ2UgTWFuYWdlbWVudDEUMBIGA1UEAxMLRXhhbXBsZS5j
b20xKzApBgkqhkiG9w0BCQEWHGpibG9nZ3NAa2VtcHRlY2hub2xvZ2llcy5jb20w
ggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQC+ohZjEwKEQT3jd6y9gN7k
Snu8E0T8bhA1LuGCD5mN++uC+3Vm4r5m6g5pVS16RF4QaRqkuiaekz5QPWqMV06b
yxveeIhoq1HPVphPOEHBHd1iotC4SLoRJ6/A0vWdlRIjlJVJfe7ka6S60xaVgAog
6lVohNoDtC2RHJOwFvawBhEZh2YzzpuoPSmDoZRnuX8qD9DZN1c9sSKn3YjomY5O
2KRyJmFEII98N8sMmiPATvXYZZCrTUifu2nwfpR9ogx7KVyK7Mi/73P41zDJdN4T
1GM0FMxYehg9bNXL27wkUek4994izLpyrv4whSc9QCbfd1BXz6IdxuFbpMJbMdVx
AgMBAAGgADANBgkqhkiG9w0BAQsFAAOCAQEANRw07oaxj+B6/t+KTMHTVWzzXFDF
79HHQj7ROFtqkw+FfijKEAfBhfNAfOpmRQEC6tWySb70K1acBn2fCI2lr9stsUUC
bq+w4Xl/crsVs+mc+veQ+p3R3zHlNPU1mZ6sofOQUi1E8NbCRUtdZ+6ixxLZL0ah
Y7aN9Ipn5qy2sT/yfYHao4rJWuzLXuKaphqyc1JNWvPkFI/4tDbrdD5rgPZfCdDY
PDOxuN2g6244Htfkn9ZCqfkatGyTI9qVnPsidqapKUAVZ4Zk1j+W7zNFGmw2cXK5
Ff97URaPLwEI+VQrVlbaJgN3/eMzLrvDB/OFD2LCv+9xk+KhAPsiDwvxJQ==
-----END CERTIFICATE REQUEST-----
```

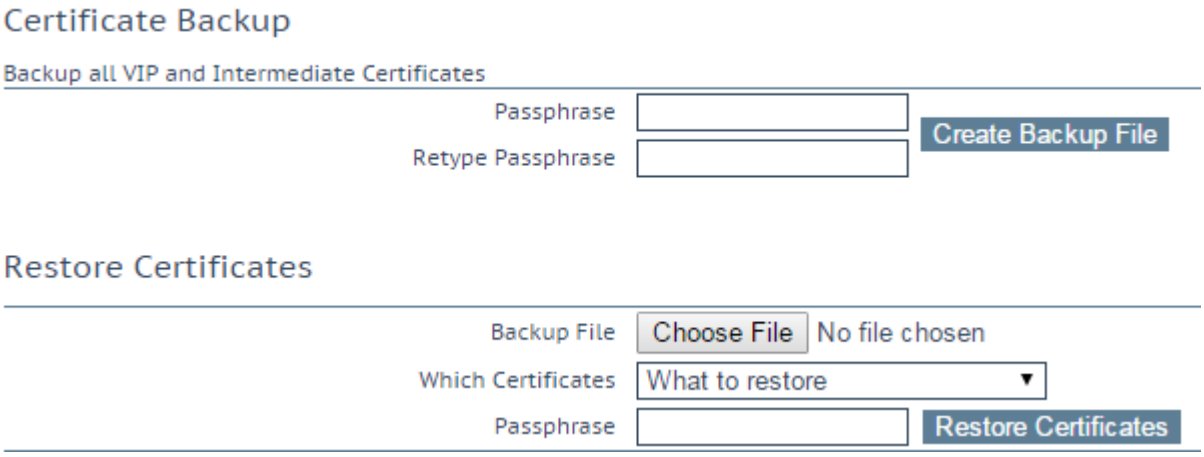
The following is your private key. Copy the following, in its entirety, and save as a .key file. Do this using a text editor such as Notepad or VI (Do not use Microsoft Word - extra characters will be added making the key unusable). Key will later be used during the certificate upload process. **DO NOT** lose or distribute this file!

```
-----BEGIN RSA PRIVATE KEY-----
MIIEpAIBAAKCAQEAvqIWYxMChEE943esvYDe5Ep7vBNE/G4QNS7hgg+Zjfvrgvt1
ZuK+ZuoOaVUtekReEGkapLomnpM+UD1qjFdOm8sb3niIaKtRz1aYTzhBwR3dYqLQ
uEi6ESevwNL1nZUSI5SVSX3u5GukutMWlYAKIOpVaITaA7QtkRyTsBb2sAYRGYdm
M86bqD0pg6GUZ7l/Kg/Q2TdXPbEip92I6JmOTtikciZhRCCPfDfLDJojwE712GWQ
q01In7tp8H6UfaIMeylciuzIv+9z+NcwyXTeE9RjNBTMWHoYPWzVy9u8JFHpOPfe
Isy6cq7+MIUnPUAm33dQV8+iHcbhW6TCWzHVcQIDAQABAoIBAQCt/fLA6pDZdVKv
UoNvUzgc1X6p4kyMuUhBwlBBDUvxs4T5P9mf1kRCWk5dBUlE1zGjeMrAnsaw5WNy
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1VzkEl1T08oqZRTJSqIbx12akk3C9QCuA/F+BiGF6Tn76epHmPYGuYykoaAZcjAV
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4bjoPxehAoGBAPr+B5lVQyuQ0Gih5fysbqX2suDX2SEM1m55Ts+xuKrog7kc36xY
xTivObfZFuE6ERQhxmGjuD8ZsVhN6giL5PMSDnvFmIL3vg4ja90zAxHKgoR2kpph
IuGfT0UOf/3+ZSTUjfLr/OEZD9uiVRBPpHeH58iWtZJ2YqmqJzMV0193AoGBAMJv
xFK1RZG7MMVXQ1JFYrk+C5A5VG80VVdYh0K+XNv6ThSHk1XqOrrIkcXzhY1qU14o
IuaSqO5+BAsbmJgx9LZlCE5xqHqHtl934WFF4GlBNcBhP9UR6ApnAtQwinWA+8k0
Ii/kAOkRAyAa2ENcT4gF/UdM38lhoid7QSw2B7xXAoGBAIJZs7Caa0wQ5WuxyTO0
ibJ/sN68uvNDK4osThXngrSgFOjqae+kGqkZt6wXfp5x/bSq5dCHqoR633Ow4z6V
CM6ELilxsYczCu1kz/wNJibzOV16ByFOGUN77Ts8EJTkrbq2+RGUJbzxux6h6/OQ
qSW621F9k8cA3LSovbr2NtR5AoGAYDI7x0+346nhL0FFJWb+uPdhcTFr/Li/oD9E
bFkSSCNGjhGla1Q/SjoBJRaedKCuLl9dJQZaXeQqy/QTQvk0QSkrOuQwnq6WJBWD
hES2Cl0g4tU6Z4g8bSkZ1TFOz2PJLnqEj30Wlji8ex3M8UaycnHEJYp7DX8oYrAw
RldU7HECgYBXd4o2+E6pNLiy7uoXXCyIZdHqapMt+MAaiFmg5cCggXbnbY3ftuxH
LDpMa6kZ/Yz10x2Uuji0QXvuh2wL1HlGCB+wJ8GgBI85FtIzaFht70WdR2HzhXY2
m1/Rl5hgtsEBdLLDg9DEN27Pr8LnTtF+7RfRFFVDWbOeDVlm+sqigQ==
-----END RSA PRIVATE KEY-----
```

The top part of the screen should be copied and pasted into a plain text file and sent to the Certificate Authority of your choice. They will validate the information and return a validated certificate.

The lower part of the screen is your private key and should be kept in a safe place. This key should not be disseminated as you will need it to use the certificate. Copy and paste the private key into a plain text file (do not use an application such as Microsoft Word) and keep the file safe.

Backup/Restore Certs



Backup all VIP and Intermediate Certificates: When backing up certificates, you are prompted to enter a mandatory passphrase (password) twice. The parameters of the passphrase are that it must be alpha-numeric and it is case sensitive with a maximum of 64 characters.

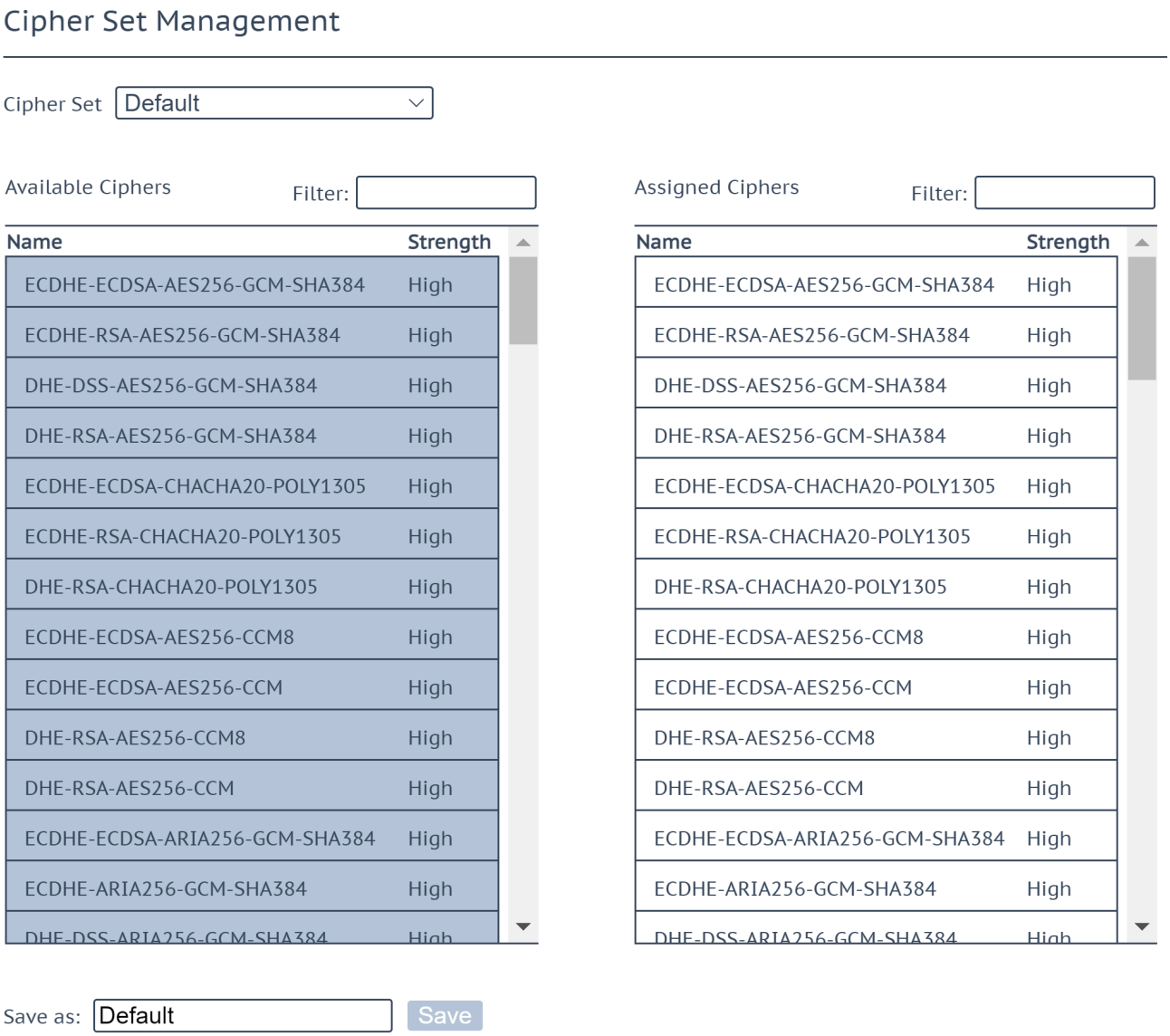
Note: This passphrase is a mandatory requirement to restore a certificate. You cannot restore a certificate without the passphrase. If you forget it, there is no way to restore the certificate.

Backup File: select the certificate backup file

Which Certificates: select which certificates you wish to restore

Passphrase: enter the passphrase associated with the certificate backup file

Cipher Sets



Cipher Set

Select the cipher set to view/modify.

The system-defined cipher sets are as follows:

- **Default:** The cipher set that is configured on the LoadMaster on a fresh installation. This cipher set is geared towards backwards compatibility with previous releases of the LoadMaster.
- **Default_NoRc4:** A more secure version of the default set that does not contain any RC4 ciphers, which are considered to be insecure on modern networks.
- **BestPractices:** This is the recommended cipher set to use on the LoadMaster and it is updated occasionally to reflect the current industry best practices. It does not include older and legacy cipher sets which may be required by older browser and application deployments. The last update to the **BestPractices** set was made in LoadMaster version 7.2.60.0. Please see the LoadMaster Release Notes

for more information.

- **Intermediate_compatibility:** This cipher set includes some ciphers that are required by older browser and service implementations that are still seen in the field.
- **Backward_compatibility:** This cipher set provides maximum backward compatibility for clients back to Windows XP/IE6 at the risk of using less secure ciphers.

Note: The **Backward_compatibility** cipher set should be used as a last resort only.

- **WUI:** This is the default cipher set used by the administrative user interface. It can be changed by using the controls under **Certificates & Security > Admin WUI Access**.
- **FIPS:** This set contains only ciphers that conform to Federal Information Processing Standards (FIPS) 140-2 level 1 standard and should be used only in those deployments that require it.
- **Legacy:** This cipher set is provided solely for upgrade compatibility for legacy LoadMaster firmware versions (v7.0-10 and previous). After upgrade to a modern version of LoadMaster, it is recommended to choose a more secure cipher set.
- **Null_Ciphers:** This cipher set contains what are called 'null ciphers', which do not provide any cryptographic protection, but rather depend on the application to provide it. In general, use these ciphers only if required by the application and if that application provides independent cryptographic protection.
- **ECDSA_Default:** This cipher set includes only cipher sets that use elliptical curve cryptography and is recommended for those deployments that require EC cryptography.
- **ECSDA_BestPractices:** This is a modified version of the ECDSA_Default set that includes only those ciphers that conform to the Common Criteria standards.

To find out what ciphers are in each cipher set, go to **Certificates & Security > Cipher Sets**. Select the relevant **Cipher Set**.

Note: Progress Kemp reserves the right to change the contents of these cipher sets at any time in response to changes in industry security standards and best practices.

Two lists are displayed – **Available Ciphers** and **Assigned Ciphers**. These lists can be filtered by typing some text into the **Filter** text boxes provided. The **Filter** text boxes will only allow you to enter valid text which is contained in the cipher names, for example **ECDHE**. If invalid text is entered, the text box will turn red and the invalid text is deleted.

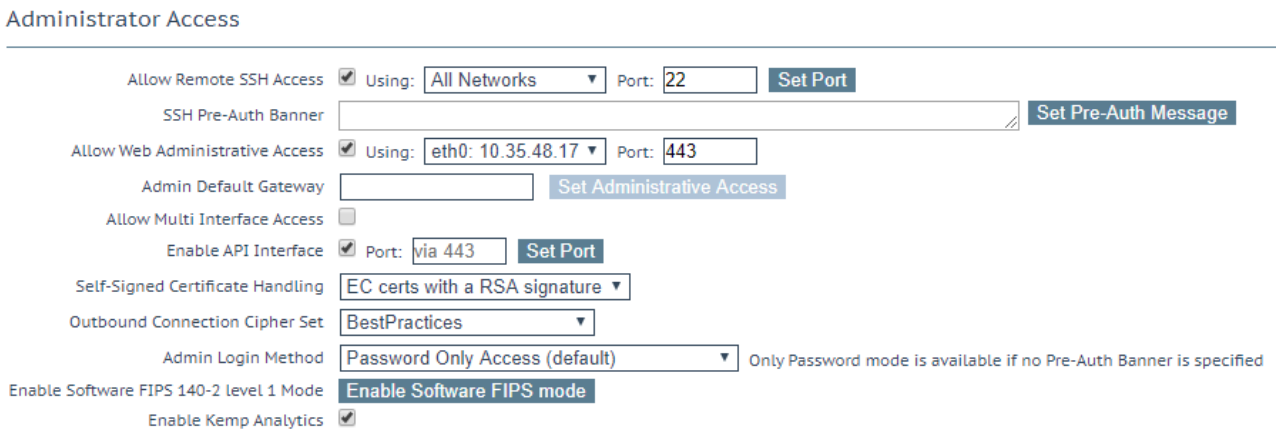
Ciphers can be dragged and dropped to/from the **Available** and **Assigned** lists as needed. Ciphers which are already assigned will appear grayed out in the **Available Ciphers** list.

Changes cannot be made to a pre-configured cipher set. However, you can start with a pre-configured cipher set – make any changes as needed and then save the cipher set with a new custom name. Enter the new name in the **Save as** text box and click the **Save** button. Custom cipher sets can be used across different Virtual Services and can be assigned as the WUI cipher set.

It is not possible to delete pre-configured cipher sets. However, custom cipher sets can be deleted by selecting the relevant custom cipher set and clicking the **Delete Cipher set** button.

Remote Access

There are some SSL-related fields on the **Remote Access** screen. These are described below.



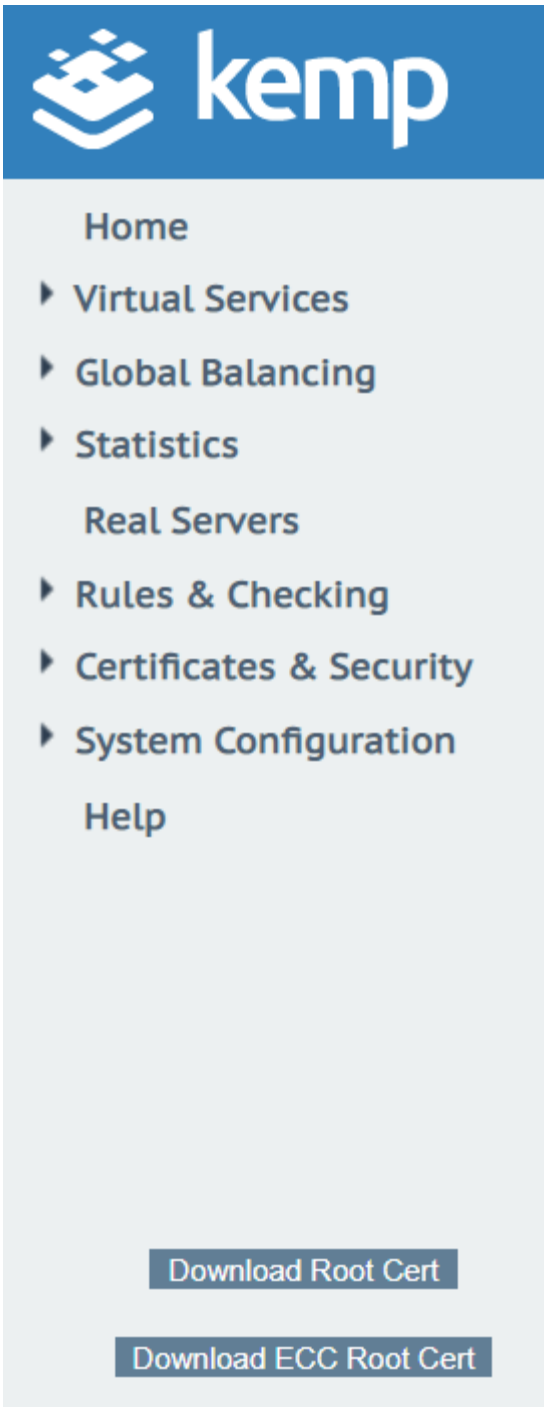
Self-Signed Certificate Handling

Select the type of self-signed certificates that the system will use for administrative access. The options are described below:

- **RSA self-signed certs:** This is the default option. The certificate will be an RSA certificate signed with the Progress Kemp RSA root certificate.
- **EC certs with a RSA signature:** The certificate used will be an RSA certificate signed with the Progress Kemp EC (Elliptical Curve) root certificate.
- **EC certs with an EC signature:** The certificate used will be an EC certificate signed with the Progress Kemp EC (Elliptical Curve) root certificate. In this mode, any CSRs generated will also be EC.

Note: If **Self-Signed Certificate Handling** is set to **EC certs with an EC signature**, CSR generation is restricted to the administrative (**bal**) user only. If **Self-Signed Certificate Handling** is set to a different value, all users (regardless of their permissions) can generate CSRs.

You should not switch from **RSA self-signed certs** to **EC certs with an EC signature** directly. If you do this, connections will fail because there is no EC Progress Kemp Certificate Authority (CA) certificate. To workaround this, you must first switch from **RSA self-signed certs** to **EC certs with a RSA signature**.



Then, download the new EC Progress Kemp CA certificate by clicking **Download ECC Root Cert** in the bottom-right of the WUI under the main menu after refreshing the page. When this certificate has been downloaded, you can switch to **EC certs with an EC signature** with no loss of connection.

Outbound Connection Cipher Set

This option allows you to select a pre-defined cipher set to use for all outbound connections, including:

- Remote logging (syslog)

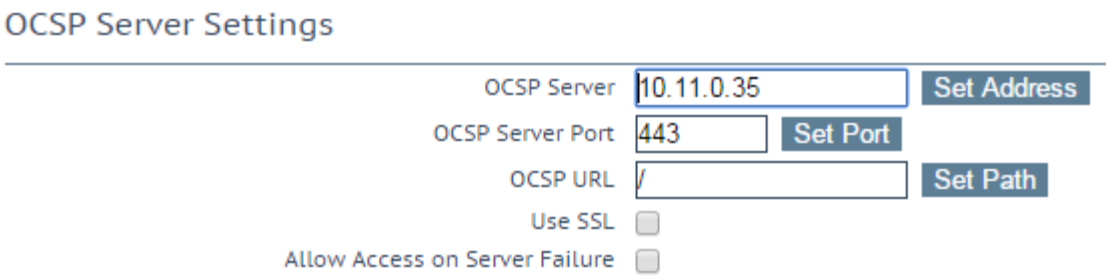
- Email notifications
- LDAP authentication
- OCSP certificate validation

The default setting is **None** (no cipher set, hence no secure connection) for backward compatibility reasons.

This is global for all outbound connections. For information on each of the cipher sets available, refer to the Cipher Sets section.

Note: The LoadMaster applies Online Certificate Status Protocol (OCSP) stapling (if enabled) to verify certificates for all outbound connections originated by LoadMaster, except for re-encrypted connections to Real Servers.

OCSP Configuration



OCSP Server

The address of the OCSP server. This can either be in IP address or Fully Qualified Domain Name (FQDN) format.

OCSP Server Port

The port of the OCSP server.

OCSP URL

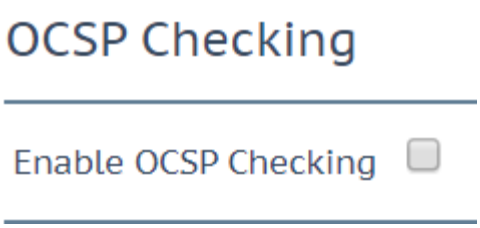
The URL to access on the OCSP server.

Use SSL

Select this to use SSL to connect to the OCSP server.

Allow Access on Server Failure

Treat an OCSP server connection failure or timeout as if the OCSP server had returned a valid response, that is, treat the client certificate as valid.



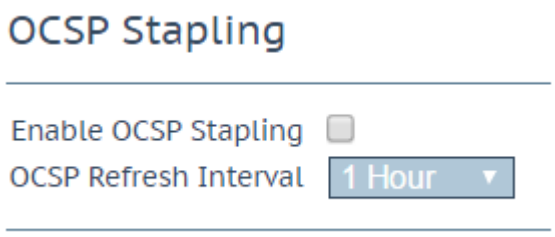
OCSP Checking

The **Enable OCSP Checking** UI control (and associated API) are all that is required in order to enable OCSP checking for outbound management connections that use certificate authentication (e.g., LDAP and remote logging).

- If the **OCSP Server/Port/URL** options are not set, all OCSP checking depends on the OCSP server setting in the AIA information from the certificate to be validated and this information is optional. If this information is not present or is invalid, no checking will be performed.
- If the **OCSP Server/Port/URL** options are set, then any certificate that does not have an OCSP server set in the AIA section will be checked using the provided OCSP server details.
- If both the certificate and the **OCSP Server/Port/URL** are set with the OCSP server address details, then only the information available in the certificate will be used to validate the certificate.If the details provided for OCSP server in the certificate are invalid, the OCSP checking will not switch to the LoadMaster OCSP server settings to validate the certificate.

The above behavior with respect to the OCSP Server/Port/URL settings also applies to OCSP checking of server certificate chains.

It should also be noted that OCSP checking for real server connections is not enabled by the above control. Real server OCSP certificate checks are enabled by the **Force Real Server Certificate** Checking option.



Enable OCSP Stapling

If the **Enable OCSP Stapling** check box is enabled, the LoadMaster verifies certificates for all external connections originated by the LoadMaster (except for re-encrypted connections to the Real Servers). Select this check box to enable the LoadMaster to respond to OCSP stapling requests. If a client connects using SSL and asks for an OCSP response, this is returned. Only Virtual Service certificates are validated. The system holds a cache of OCSP responses that are sent back to the client. This cache is maintained by the OCSP daemon. When the OCSP daemon sends a request to the server, it uses the name specified in the certificate (in the **Authority Information Access** field). If it cannot resolve this name, then it uses the default OCSP server specified in the **OCSP Server** text box.

OCSP Refresh Interval

Specify how often the LoadMaster should refresh the OCSP stapling information. The OCSP daemon caches the entry for up to the amount of time specified here, after which it is refreshed. Valid values range from 1 hour (default) to 24 hours.

4

How to Get an A+ Rating with SSL Labs

To achieve an A or A+ rating from SSL Labs while using the LoadMaster's SSL acceleration function, first you must download and apply the latest firmware version. This prevents the latest protocol attacks and addresses critical vulnerabilities. Refer to the LoadMaster Release Notes for further details.

The latest firmware can be downloaded from the following page: LoadMaster Downloads.

In general, there four main components that determine the strength of a given site's SSL implementation: certificate, protocol support, key exchange, and cipher strength.

Certificates

Ensure that your certificate has been issued by an authorized Certificate Authority (CA).

SSL chain issues in an SSL Labs report means that there is a missing intermediate certificate from your LoadMaster. To resolve this chain issue, you must upload and apply an intermediate certificate from your CA's website to your LoadMaster. From more information, refer to the How to Troubleshoot SSL Certificate Chain Issues section.

For step-by-step instructions on how to upload your certificate to the LoadMaster, refer to the Adding an SSL Certificate section.

For step-by-step instructions on how to upload your intermediate certificate to the LoadMaster, refer to the Importing Intermediate Certificates section.

Protocol Support

In the **SSL Properties** section of your Virtual Services, disable **SSLv3**, **TLS1.0**, and **TLS1.1** as **Supported Protocols**. So, only **TLS1.2** and **TLS1.3** are enabled.

Enable Require SNI Hostname

We recommend enabling the **Require SNI hostname** check box in the **SSL Properties** section of the Virtual Service modify screen.

Key Exchange and Cipher Strength

We recommend selecting the **BestPractices Cipher Set** in the **SSL Properties** section of the Virtual Service modify screen. This cipher set is for services that do not require backward compatibility. This cipher set provides the greatest compatibility while still maintaining an A rating. However, Windows XP clients using Internet Explorer 6 will not be able to connect. If this is necessary, re-enable **SSLv3**.

HSTS (HTTP Strict Transport Security)

To get the A+ rating, SSL Labs requires you to use HSTS. Refer to the following Knowledge Base article to add HSTS to your Virtual Service: HTTP Strict Transport Security.

5

How to Troubleshoot SSL Certificate Chain Issues

SSL certificates can be trusted on a main browser and function correctly but it can still have chain issues. This problem can result in the application failing, especially on mobile devices and other browsers, because the certificate is deemed untrusted.

To identify a chain issue:

1. In your browser, go to the following SSL Labs page: SSL Server Test.
2. Enter the **Hostname** and click **Submit**.
3. Once the SSL test is completed, look in the **Additional Certificates** section. If there is a chain issue it will show **Incomplete** for **Chain issues**.

To resolve the chain issue:

Search your Certificate Authority's (CA) website to download their intermediate CA file. This file links all of the trusted CA certificates needed to reach the root certificate. When this Intermediate CA file has been downloaded, you must upload it to the LoadMaster. For more information, refer to the Importing Intermediate Certificates section.

After you upload the intermediate CA file to the LoadMaster, run the SSL server test again.

6

References

Unless otherwise specified, the following documents can be found at: https://docs.progress.com/.

Web User Interface (WUI), Configuration Guide

LoadMaster, Product Overview

DoD Common Access Card (CAC) Authentication, Feature Description

RESTful API, Interface Description

SSL Accelerated Services for the FIPS, Feature Description