



U Y U N I

# Quick Start - Uyuni

Uyuni 2021.05

2021년06월23일



# 차례

|  |    |
|--|----|
| Quick Start: Uyuni Overview                                | 1  |
| Install Uyuni Server with openSUSE Leap                    | 2  |
| Software and Hardware Requirements                         | 2  |
| Install Uyuni Server on openSUSE Leap                      | 2  |
| Set up Uyuni Server with YaST                              | 3  |
| Create the Main Administration Account                     | 4  |
| Optional: Synchronizing Products from SUSE Customer Center | 4  |
| Install Uyuni Proxy with openSUSE Leap                     | 6  |
| Mirror Uyuni Proxy software                                | 6  |
| Register the openSUSE Leap system                          | 6  |
| Install Uyuni Proxy on openSUSE Leap                       | 7  |
| Prepare the Proxy  | 7  |
| Set Up the Proxy   | 8  |
| Configure DHCP for PXE through Proxy                       | 11 |
| Reinstalling a Proxy                                       | 11 |
| More Information   | 12 |
| GNU Free Documentation License                             | 13 |

# Quick Start: Uyuni Overview

**Updated:** 2021-06-23

This guide shows you how to use install and configure a single Uyuni Server.

This guide is specific to Uyuni, and does not apply to setting up a SUSE Manager Server.

For more information about Uyuni, see <https://www.uyuni-project.org/uyuni-docs>. For more information about SUSE Manager, see <https://documentation.suse.com/suma>.

# Install Uyuni Server with openSUSE Leap

Uyuni Server can be installed on openSUSE Leap.

- For information about the stable version of Uyuni, see <https://www.uyuni-project.org/pages/stable-version.html>.
- For information about the development version of Uyuni, see <https://www.uyuni-project.org/pages/devel-version.html>.
- For information about the latest version and updates of openSUSE Leap, see <https://doc.opensuse.org/release-notes/>.

## Software and Hardware Requirements

This table shows the software and hardware requirements for installing an Uyuni Server on openSUSE Leap.

Table 1. Software and Hardware Requirements

| Software and Hardware | Recommended   |
|-----------------------|---|
| Operating System:     | openSUSE Leap 15.2: Clean installation, up-to-date                |
| CPU:                  | Minimum 4 dedicated 64-bit x86_64CPU cores                        |
| RAM:                  | Test Server Minimum 8 GB<br>Base Installation Minimum 16 GB       |
|                       | Production Server Minimum 32 GB                                   |
| Disk Space:           | Disk space depends on your channel requirements, at least 100 GB  |
|                       | 50 GB per SUSE or openSUSE product and 360 GB per Red Hat product |
| Swap space:           | 3 GB  |

## Install Uyuni Server on openSUSE Leap

You can use a physical or virtual machine running openSUSE Leap to install the Uyuni Server. Configure a resolvable fully-qualified domain name on the server before you begin, to ensure that the server is accessible across the network.

The Uyuni Server software is available from [download.opensuse.org](http://download.opensuse.org), and you can use zypper to retrieve the software and install it.

Procedure: Installing openSUSE Leap with Uyuni

- Install openSUSE Leap as the base system, and ensure all available service packs and package updates have been applied.
- Configure a resolvable fully qualified domain name (FQDN) with YaST by navigating to **System > Network Settings > Hostname/DNS**.

- At the command prompt, as root, add the repository for installing the Uyuni Server software:

```
repo=repositories/systemsmanagement:/  
repo=${repo}Uyuni:/Stable/images/repo/Uyuni-Server-POOL-x86_64-Media1/  
zypper ar https://download.opensuse.org/$repo uyuni-server-stable
```

- Refresh metadata from the repositories:

```
zypper ref
```

- Install the pattern for the Uyuni Server:

```
zypper in patterns-uyuni_server
```

- Reboot the server.

When the installation is complete, you can continue with Uyuni setup. For more information, see [[Installation > Uyuni-server-setup >](#)].

## Set up Uyuni Server with YaST

The initial setup procedure is handled by YaST.

Procedure: Uyuni Setup

- Log in to the Uyuni Server and start YaST.
- In YaST, navigate to **Network Services > Uyuni Setup** to begin the setup.
- From the introduction screen select **Uyuni Setup > Set up Uyuni from scratch** and click **[Next]** to continue.
- Enter an email address to receive status notifications and click **[Next]** to continue. Uyuni can sometimes send a large volume of notification emails. You can disable email notifications in the WebUI after setup, if you need to.
- Enter your certificate information and a password. Passwords must be at least seven characters in length, and must not contain spaces, single or double quotation marks (' or "), exclamation marks (!), or dollar signs (\$). Always store your passwords in a secure location.



If you need to also set up a Uyuni Proxy Server, ensure you have taken a note of the certificate password.

- Click **[Next]** to continue.
- From the **Uyuni Setup > Database Settings** screen, enter a database user and password and click **[Next]** to continue. Passwords must be at least seven characters in length, and must not contain

spaces, single or double quotation marks (' or "), exclamation marks (!), or dollar signs (\$). Always store your passwords in a secure location.

8. Click **[Next]** to continue.
9. Click **[Yes]** to run setup when prompted.
10. When setup is complete, click **[Next]** to continue. You will see the address of the Uyuni WebUI.
11. Click **[Finish]** to complete Uyuni setup.

## Create the Main Administration Account

Before you can log in to the server to manage your clients, you need to have created an administration account. The main administration account has the highest authority within Uyuni. Ensure you keep access information for this account secure. We recommend that you create lower level administration accounts for organizations and groups. Do not share the main administration access details.

Procedure: Setting Up the Main Administration Account

1. In your web browser, enter the address for the Uyuni WebUI. This address was provided after you completed setup.
2. Sign in to the WebUI, navigate to the **Create Organization > Organization Name** field, and enter your organization name.
3. In the **Create Organization > Desired Login** and **Create Organization > Desired Password** fields, enter your username and password.
4. Fill in the account information fields, including an email for system notifications.
5. Click **[Create Organization]** to finish creating your administration account.

When you have completed the Uyuni WebUI setup, you are taken to the **Home > Overview** page.

## Optional: Synchronizing Products from SUSE Customer Center

SUSE Customer Center (SCC) maintains a collection of repositories which contain packages, software and updates for all supported enterprise client systems. These repositories are organized into channels each of which provide software specific to a distribution, release, and architecture. After synchronizing with SCC, clients can receive updates, be organized into groups, and assigned to specific product software channels.

This section covers synchronizing with SCC from the WebUI and adding your first client channel.



For Uyuni, synchronizing products from SUSE Customer Center is optional.

Before you can synchronize software repositories with SCC, you will need to enter organization credentials in Uyuni. The organization credentials give you access to the SUSE product downloads. You will find your organization credentials in <https://scc.suse.com/organizations>.

Enter your organization credentials in the Uyuni WebUI:

---

#### Optional Procedure: Entering Organization Credentials

1. In the Uyuni WebUI, navigate to **Admin > Setup Wizard**.
2. In the **Setup Wizard** page, navigate to the **[Organization Credentials]** tab.
3. Click **[Add a new credential]**.
4. Enter a username and password, and click **[Save]**.

A check mark icon is shown when the credentials are confirmed. When you have successfully entered the new credentials, you can synchronize with SUSE Customer Center.

#### Optional Procedure: Synchronizing with SUSE Customer Center

1. In the Uyuni WebUI, navigate to **Admin > Setup Wizard**.
2. From the **Setup Wizard** page select the **[SUSE Products]** tab. Wait a moment for the products list to populate. If you previously registered with SUSE Customer Center a list of products will populate the table. This table lists architecture, channels, and status information.
3. If your SUSE Linux Enterprise client is based on **x86\_64** architecture scroll down the page and select the check box for this channel now.
4. Add channels to Uyuni by selecting the check box to the left of each channel. Click the arrow symbol to the left of the description to unfold a product and list available modules.
5. Click **[Add Products]** to start product synchronization.

When a channel is added, Uyuni will schedule the channel for synchronization. Depending on the number and size of this channels, this can take a long time. You can monitor synchronization progress in the WebUI.

For more information about using the setup wizard, see **[ Reference > Admin > Wizard ]**.

When the channel synchronization process is complete, you can register and configure clients. For more instructions, see **[ Client-configuration > Registration-overview > ]**.

# Install Uyuni Proxy with openSUSE Leap

Uyuni Proxy can be installed as a server extension on openSUSE Leap. The proxy is installed in the same way as a client, but is designated as a proxy server during installation. This is achieved by adding the Uyuni Proxy pattern, and executing the proxy setup script.

- For more information about the stable version of Uyuni, see <https://www.uyuni-project.org/pages/stable-version.html>.
- For more information about the development version of Uyuni, see <https://www.uyuni-project.org/pages/devel-version.html>.

## Mirror Uyuni Proxy software

The Uyuni Proxy software is available from <https://download.opensuse.org>. You can synchronize the proxy software to your Uyuni Server. This process is also known as mirroring.

Procedure: Mirroring Uyuni Proxy software

1. On the Uyuni Server, create openSUSE Leap and the Uyuni Proxy channels with the `spacewalk-common-channels` command. `spacewalk-common-channels` is part of the `spacewalk-utils` package:

```
spacewalk-common-channels \
opensuse_leap15_2 \
opensuse_leap15_2-non-oss \
opensuse_leap15_2-non-oss-updates \
opensuse_leap15_2-updates \
opensuse_leap15_2-uyuni-client \
uyuni-proxy-stable-leap-152
```

Instead of the `uyuni-proxy-stable-leap-152` version you can also try the latest development version, called `uyuni-proxy-devel-leap`. For more information, see [ [Client-configuration](#) > [Clients-opensuse](#) ].

## Register the openSUSE Leap system

Begin by installing openSUSE Leap on a physical or virtual machine. To ensure that the proxy is accessible across the network, you must have a resolvable fully-qualified domain name (FQDN) on the openSUSE Leap system before you begin the installation. You can configure an FQDN with YaST by navigating to [System](#) > [Network Settings](#) > [Hostname/DNS](#).

When you have installed openSUSE Leap on the proxy and configured the FQDN, you can prepare the Uyuni Server, and register the openSUSE Leap system as a client.

Procedure: Registering the openSUSE Leap system

1. On the Uyuni Server, create an activation key with openSUSE Leap as a base channel and the proxy

and the other channels as child channels. For more information about activation keys, see [ [Client-configuration > Activation-keys](#) ].

2. Modify a bootstrap script for the proxy. Ensure you add the GPG key for Uyuni to the `ORG_GPG_KEY=` parameter. For example:

```
ORG_GPG_KEY=uyuni-gpg-pubkey-0d20833e.key
```

For more information, see [xref:client-configuration:clients-openSUSE.adoc](#) [ ].

3. Bootstrap the client using the script. For more information, see [ [Client-configuration > Registration-bootstrap](#) ].
4. Navigate to **Salt > Keys** and accept the key. When the key is accepted, the new proxy will show in **Systems > Overview** in the **Recently Registered Systems** section.
5. Navigate to **System Details > Software > Software Channels**, and check that the proxy channel is selected.

## Install Uyuni Proxy on openSUSE Leap

On the client, use the `zypper` command line tool or on the Uyuni Server, the WebUI to install the proxy software on openSUSE Leap.

Procedure: Installing Uyuni Proxy on openSUSE Leap

1. Install the pattern for the Uyuni Proxy. You can do this either on the client or on the server.
  - For the client, use `zypper`

```
zypper in patterns-uyuni_proxy
```

- Alternatively, on the Uyuni Server, use the WebUI. Navigate to the details tab of the client, click **Software > Packages > Install**, and schedule `patterns-uyuni_proxy` for installation.
1. Reboot the client.

## Prepare the Proxy

Before you begin, ensure that the proxy pattern is installed correctly. To verify a successful installation, on the Uyuni Server, select the `pattern_uyuni_proxy` package for installation.

The salt-broker service is automatically started after installation is complete. This service forwards the Salt interactions to the Uyuni Server.



It is possible to arrange Salt proxies in a chain. In this case, the upstream proxy is named **parent**.

Make sure the TCP ports **4505** and **4506** are open on the proxy. The proxy must be able to reach the Uyuni Server or a parent proxy on these ports.

The proxy shares some SSL information with the Uyuni Server. You need to copy the certificate and its key from the Uyuni Server or the parent proxy to the proxy you are setting up.

Procedure: Copying the Server Certificate and Key

1. On the proxy you are setting up, at the command prompt, as root, create a directory for the certificate and key:

```
mkdir -m 700 /root/ssl-build
cd /root/ssl-build
```

2. Copy the certificate and the key from the source to the new directory. In this example, the source location is called **PARENT**. Replace this with the correct path:

```
scp root@<PARENT>:/root/ssl-build/RHN-ORG-PRIVATE-SSL-KEY .
scp root@<PARENT>:/root/ssl-build/RHN-ORG-TRUSTED-SSL-CERT .
scp root@<PARENT>:/root/ssl-build/rhn-ca-openssl.cnf .
```



To keep the security chain intact, the Uyuni Proxy functionality requires the SSL certificate to be signed by the same CA as the Uyuni Server certificate. Using certificates signed by different CAs for proxies and server is not supported. For more information on how Uyuni handles certificates, see [[Administration > Ssl-certs >](#)].

## Set Up the Proxy

When you have prepared the proxy, use the supplied interactive **configure-proxy.sh** script to complete the proxy setup.

Procedure: Setting up the Proxy

1. On the proxy you are setting up, at the command prompt, as root, execute the setup script:

```
configure-proxy.sh
```

2. Follow the prompts to set up the proxy. Leave a field blank and type **Enter** to use the default values shown between square brackets.

More information about the settings set by the script:

### Uyuni Parent

the Uyuni parent can be either another proxy or a server.

### HTTP Proxy

A HTTP proxy enables your Uyuni Proxy to access the Web. This is needed if direct access to the Web is prohibited by a firewall.

### Traceback Email

An email address where to report problems.

### Do You Want to Import Existing Certificates?

Answer **N**. This ensures using the new certificates that were copied previously from the Uyuni server.

### Organization

The next questions are about the characteristics to use for the SSL certificate of the proxy. The organization might be the same organization that was used on the server, unless of course your proxy is not in the same organization as your main server.

### Organization Unit

The default value here is the proxy's hostname.

### City

Further information attached to the proxy's certificate.

### State

Further information attached to the proxy's certificate.

### Country Code

In the **country code** field, enter the country code set during the Uyuni installation. For example, if your proxy is in the US and your Uyuni is in DE, enter **DE** for the proxy.



The country code must be two upper case letters. For a complete list of country codes, see <https://www.iso.org/obp/ui/#search>.

### Cname Aliases (Separated by Space)

Use this if your proxy can be accessed through various DNS CNAME aliases. Otherwise it can be left empty.

### CA Password

Enter the password that was used for the certificate of your Uyuni Server.

## Do You Want to Use an Existing SSH Key for Proxying SSH-Push Salt Minion?

Use this option if you want to reuse a SSH key that was used for SSH-Push Salt clients on the server.

## Create and Populate Configuration Channel rhn\_proxy\_config\_1000010001?

Accept default **Y**.

### SUSE Manager Username

Use same user name and password as on the Uyuni server.

If parts are missing, such as CA key and public certificate, the script prints commands that you must execute to integrate the needed files. When the mandatory files are copied, run `configure-proxy.sh` again. If you receive an HTTP error during script execution, run the script again.

`configure-proxy.sh` activates services required by Uyuni Proxy, such as `squid`, `apache2`, `salt-broker`, and `jabberd`.

To check the status of the proxy system and its clients, click the proxy system's details page on the WebUI (**Systems** > **System List** > **Proxy**, then the system name). **Connection** and **Proxy** subtabs display various status information.

If you want to PXE boot your clients from your Uyuni Proxy, you also need to synchronize the TFTP data from the Uyuni Server. For more information about this synchronization, see [**Client-configuration** > **Autoinst-pxeboot** >].

Procedure: Synchronizing Profiles and System Information

1. On the proxy, at the command prompt, as root, install the `susemanager-tftpsync-recv` package:

```
zypper in susemanager-tftpsync-recv
```

2. On the proxy, run the `configure-tftpsync.sh` setup script and enter the requested information:

```
configure-tftpsync.sh
```

You need to provide the hostname and IP address of the Uyuni Server and the proxy. You also need to enter the path to the `tftpboot` directory on the proxy.

3. On the server, at the command prompt, as root, install `susemanager-tftpsync`:

```
zypper in susemanager-tftpsync
```

4. On the server, run `configure-tftpsync.sh` setup script and enter the requested information:

```
configure-tftpsync.sh
```

- Run the script again with the fully-qualified domain name of the proxy you are setting up. This creates the configuration, and uploads it to the Uyuni Proxy:

```
configure-tftpsync.sh FQDN_of_Proxy
```

- On the server, start an initial synchronization:

```
cobbler sync
```

You can also synchronize after a change within Cobbler that needs to be synchronized immediately. Otherwise Cobbler synchronization will run automatically when needed. For more information about PXE booting, see [ [Client-configuration > Autoinst-pxeboot > Install via the Network](#) ].

## Configure DHCP for PXE through Proxy

Uyuni uses Cobbler for client provisioning. PXE (tftp) is installed and activated by default. Clients must be able to find the PXE boot on the Uyuni Proxy using DHCP. Use this DHCP configuration for the zone which contains the clients to be provisioned:

```
next-server: <IP_Address_of_Proxy>
filename: "pxelinux.0"
```

## Reinstalling a Proxy

A proxy does not contain any information about the clients that are connected to it. Therefore, a proxy can be replaced by a new one at any time. The replacement proxy must have the same name and IP address as its predecessor.

For more information about reinstalling a proxy, see [ [Installation > Proxy-setup](#) ].

Proxy systems are registered as Salt clients using a bootstrap script.

This procedure describes software channel setup and registering the installed proxy with an activation key as the Uyuni client.



Before you can select the correct child channels while creating the activation key, ensure you have properly synchronized the openSUSE Leap channel with all the needed child channels and the Uyuni Proxy channel.

## More Information

For more information about the Uyuni project, and to download the source, see <https://www.uyuni-project.org/>.

For more Uyuni product documentation, see <https://www.uyuni-project.org/uyuni-docs/uyuni/index.html>.

To raise an issue or propose a change to the documentation, use the links under the **Resources** menu on the documentation site.

# GNU Free Documentation License

Copyright © 2000, 2001, 2002 Free Software Foundation, Inc. 51 Franklin St, Fifth Floor, Boston, MA 02110-1301 USA. Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

## 0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

## 1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

A section "Entitled XYZ" means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as "Acknowledgements", "Dedications", "Endorsements", or "History".) To "Preserve the Title" of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

## 2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

## 3. COPYING IN QUANTITY

---

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

## 4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

- A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
- B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.
- C. State on the Title page the name of the publisher of the Modified Version, as the publisher.
- D. Preserve all the copyright notices of the Document.
- E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
- F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.
- G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in

---

the Document's license notice.

- H. Include an unaltered copy of this License.
  - I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.
  - J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
  - K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.
  - L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
  - M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.
  - N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.
  - O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties—for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

## 5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the

Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements".

## 6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

## 7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

## 8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

## 9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

## 10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See <http://www.gnu.org/copyleft/>.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

## ADDENDUM: How to use this License for your documents

Copyright (c) YEAR YOUR NAME.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts.

A copy of the license is included in the section entitled{ldquo}GNU Free Documentation License{rdquo}.

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the "with...Texts." line with this:

with the Invariant Sections being LIST THEIR TITLES, with the Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

---

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.