



U Y U N I

Upgrade Guide

Uyuni 4.1

February 04, 2021

Table of Contents

Upgrade Guide Overview	1
Upgrade the Server	2
Server - Minor Upgrade	2
Server - Major Upgrade.	3

Upgrade Guide Overview

Publication Date: 2021-02-04

Uyuni has three main components, all of which need regular updates. This guide covers updating the Uyuni Server, Proxy, and clients, as well as some underlying components, such as the database.

It is possible to automate some of the upgrades, but others need to be performed manually.



This guide is not intended to be read cover to cover. Instead, navigate to the component you want to upgrade, then identify the versions you are upgrading from and to.

Uyuni uses an **YYYY.MM** versioning schema suitable for rolling releases. If you are upgrading the Uyuni Server, see [**Upgrade > Server-intro-uyuni >**].

If you are upgrading the Uyuni Proxy, see [**Upgrade > Proxy-intro >**].

If you are upgrading clients, see [**Upgrade > Client-intro >**].

In addition to upgrading the server, you need to upgrade other underlying technologies, including the database. For more information about upgrading the database, see [**Upgrade > Db-intro >**].

Upgrade the Server

Uyuni uses a rolling release versioning schema. Check the release notes for information about which upgrade strategy to use to upgrade to the next version:

Minor Upgrades

You can consider minor upgrades as regular upgrades. For more information, see [**Upgrade > Server-minor-upgrade-uyuni >**].

Major Upgrades

You can consider major upgrades as special upgrades. In this case components such as the base operating system, Salt, or the PostgreSQL database will be upgraded. For more information, see [**Upgrade > Server-major-upgrade-uyuni >**].

Server - Minor Upgrade

Several times a year, the Uyuni team releases minor upgrades of the Uyuni Server. These updates address bug fixes and feature improvements, and sometimes include new features.



Some additional manual steps might be required, and this information is only available in the release notes. For important extra information about your upgrade, see the release notes at <https://www.uyuni-project.org/pages/stable-version.html>.

Performing a minor upgrade is similar to installing operating system package updates.

Procedure: Updating Packages on the Uyuni Server

By default, several update repositories are configured and enabled for the Uyuni Server. New and updated packages become available automatically.

1. On the Uyuni Server, at the command prompt, as root, stop the spacewalk services:

```
spacewalk-service stop
```

2. List available patches:

```
zypper list-patches
```

3. Apply all available patches:

```
zypper patch
```

This command only applies patches. To apply all outstanding updates, use **zypper up** instead.

4. Restart the spacewalk services:

```
spacewalk-service start
```

Reboot the server if a patch update recommends rebooting.



By default, zypper refreshes the repository every ten minutes (see `repo.refresh.delay` in `/etc/zypp/zypp.conf`). If `autorefresh` is disabled, run `zypper ref` to refresh all repositories.



Starting with Uyuni 2020.04 `spacewalk-schema-upgrade` is not needed anymore.

The schema upgrade is run automatically when the spacewalk service is started with `spacewalk-service start`.



Services affected by a package update are not automatically restarted after an update. You need to restart these services manually to avoid potential failures. Use `zypper ps` to check for applications that are using old code and require restarting.

Server - Major Upgrade

When Uyuni core components are upgraded to new major versions, you need to perform a major upgrade on the Uyuni Server. This is the case if a version upgrade of PostgreSQL, Salt, or openSUSE Leap is needed. openSUSE Leap is the underlying base operating system (OS).



Some additional manual steps might be required, and this information is only available in the release notes. For important extra information about your upgrade, see the release notes at <https://www.uyuni-project.org/pages/stable-version.html>.

Procedure: Migrating the Uyuni Server

The `server-migrator.sh` script migrates Uyuni Server to the latest version. It also upgrades the underlying operating system to version 15.2. The script is part of the `susemanager` package.

1. Before running the `server-migrator.sh` script, check whether the most recent version of the `susemanager` package is installed:

```
zypper ref
zypper up susemanager
```

2. Run the `/usr/lib/susemanager/bin/server-migrator.sh` script to upgrade the base OS and Uyuni Server.
3. To migrate the database to PostgreSQL 12 run the migrate script:

```
/usr/lib/susemanager/bin/pg-migrate-10-to-12.sh
```

For more information about PostgreSQL database migration, see [db-migration-12.pdf](#).

4. To migrate the database to PostgreSQL 13 run the migration script:

```
/usr/lib/susemanager/bin/pg-migrate-12-to-13.sh
```

For more information about PostgreSQL database migration, see [db-migration-13.pdf](#).



Postgresql 12 or postgresql 13?

This depends on the underlying operating system. Leap 15.2 shipped version 12 and this is the version used by uyuni on that OS. Leap 15.3 is expected to have postgresql 13, so expect postgresql version 13.

1. After the migration is complete, you will need to manually reboot the Uyuni Server:

```
shutdown -r now
```

You will not be able to fix issues that arise during the migration. Ensure you have created a backup before you start the migration. If you are running Uyuni Server on a virtual machine, we recommend that you create a snapshot before you start.

= Upgrade the Proxy

Uyuni Proxies are managed in the same way as clients.

Before you perform any proxy update, schedule a maintenance window. The clients registered to Uyuni through the proxy will not be able to connect to Uyuni while the update is in progress. For more information about maintenance windows, see [**Administration** > **Maintenance-windows** >].

= Proxy - Upgrade Procedure

Before you perform any proxy update, schedule a maintenance window. The clients registered to Uyuni through the proxy will not be able to connect to Uyuni while the update is in progress. For more information about maintenance windows, see [**Administration** > **Maintenance-windows** >].

== Preparation

As a preparation step, add the openSUSE Leap 15.2 channels to the server.

Procedure: Adding Software Channels at the Command Prompt

1. At the command prompt on the Uyuni Server, as root, use the **spacewalk-common-channels** command to add the appropriate channels:

```
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
```

2. Fully synchronize all channels with **spacewalk-repo-sync**. In case of already defined repository URLs, continue with [\[uyuni-202007-channeldupes\]](#).

== Troubleshooting Duplicate Repository URLs

If you add two or more repositories with the same URL (client tools for openSUSE Leap 15.0, 15.1, and 15.2) in Uyuni with **spacewalk-common-channels**, an error like this is shown:

```
ERROR: opensuse_leap15_2-uyuni-client-x86_64:
redstone.xmlrpc.XmlRpcFault: There's already a defined repository with given url,
please reuse it
```

Work around with assigning the 15.1 repository to the 15.2 channel:

Procedure: Assigning 15.1 Repositories to the 15.2 Channel:

1. In the Uyuni Server WebUI, navigate to **Software** > **Manage** > **Channels** and click the **Uyuni Client Tools for openSUSE Leap 15.2 (x86_64)** channel name.

2. In the upper right corner, click **[Manage Channel]**.
3. Navigate to the **Repositories** tab, and select **External - Uyuni Client Tools for openSUSE Leap 15.1 (x86_64)**.
4. Click **[Update Repositories]**.
5. Navigate to **Repositories > Sync** subtab, and click **[Sync Now]**.
6. Do the same with **Uyuni Proxy Stable for openSUSE Leap 15.2 (x86_64)** and **External - Uyuni Proxy Stable for openSUSE Leap 15.1 (x86_64)**.

Expand the **openSUSE Leap 15.2 (x86_64)** channel to see the child channels populated with packages.

== Upgrade the Proxy

To upgrade a proxy you first stop the proxy service, then you replace the software repositories and update the software, and finally you restart the proxy service.

Procedure: Updating the Uyuni Proxy

1. In the Uyuni Server WebUI, navigate to proxy system's details page, click the **Reactivation** subtab.
2. Click **[Generate New Key]** to generate a reactivation key.
3. On the Uyuni Proxy, stop the proxy service:

```
spacewalk-proxy stop
```

4. In the Uyuni Server WebUI, navigate to **Systems > Proxy** and click the name of the proxy.
5. Click **Software > Software Channels**, and as the base channel select the openSUSE Leap 15.2 channel that is listed in the **Customs Channels** list.
6. In the **Child Channels** pane, select the 15.2 child channels.
7. Click **[Next]**, and **Confirm Software Channel Change** with **[Confirm]**.
8. Click **Software > Packages > Upgrade**, and select all the packages to be updated on the proxy, and then apply the selection.
9. Re-register with the reactivation key using the **rhndreg_ks** command-line utility. The system is re-registered with the same ID, history, and groups.
10. On the Uyuni Proxy, start the proxy service:

```
spacewalk-proxy start
```

If you need to update many proxies, you can create an action chain of this command sequence on the Uyuni Server. You can use the action chain to perform updates on multiple proxies at the same

time.

= Upgrade the Clients

Clients use the versioning system of their underlying operating system. For clients using SUSE operating systems, you can perform upgrades within the Uyuni WebUI.

For more information about upgrading clients, see [**Client-configuration > Client-upgrades >**].

= Upgrade the Database

To successfully perform a major Uyuni update, you might need to upgrade the underlying database.

If you are using PostgreSQL 9, and you are upgrading to version 10, see [**Upgrade > Db-migration-10 >**]. If you are using PostgreSQL 10, and you are upgrading to version 12, see [**Upgrade > Db-migration-12 >**].

If you want to upgrade to the latest Uyuni version, you must be using PostgreSQL version 10 or 12. If you are using an older version, such as version 9.6, you must migrate PostgreSQL to version 10 before you begin the Uyuni migration.

If you run PostgreSQL 9.4 on Uyuni 3.2, see the product documentation at <https://documentation.suse.com/external-tree/en-us/suma/3.2/susemanager-best-practices/html/book.suma.best.practices/bp.sp.migration.html#sp.migration.postgresql>. You cannot migrate directly from PostgreSQL 9.4 to version 10.

This table shows the PostgreSQL version required for each version of Uyuni and SUSE Linux Enterprise Server:

Table 1. PostgreSQL Versions

Uyuni version	Operating System version	PostgreSQL version
Uyuni 3.1.4	SLES 12 SP3	Postgres 9.6
Uyuni 3.1.11	SLES 12 SP3	Postgres 9.6
Uyuni 3.2.10	SLES 12 SP3	Postgres 9.6
Uyuni 3.2.10	SLES 12 SP3	Postgres 10
Uyuni 3.2.10	SLES 12 SP4	Postgres 10
Uyuni 4.0.0	SLES 15 SP1	Postgres 10
Uyuni 4.1.0	SLES 15 SP2	Postgres 12
Uyuni 4.2.0	SLES 15 SP3	Postgres 13

= Database Migration from Version 9 to 10

This section covers upgrading the PostgreSQL database from version 9 to version 10. If you are already using PostgreSQL 10, you do not need to perform this migration.

If you want to upgrade to the latest Uyuni version, you must be using PostgreSQL version 10 or 12. If you are using an older version, such as version 9.6, you must migrate PostgreSQL to version 10 before you begin the Uyuni migration.

If you run PostgreSQL 9.4 on Uyuni 3.2, see the product documentation at <https://documentation.suse.com/external-tree/en-us/suma/3.2/susemanager-best-practices/html/book.suma.best.practices/bp.sp.migration.html#sp.migration.postgresql>. You cannot migrate directly from PostgreSQL 9.4 to version 10.

== Prepare to Upgrade

Before you begin the upgrade, prepare your existing Uyuni Server and create a database backup.

PostgreSQL stores data at `/var/lib/pgsql/data/`.

Procedure: Preparing to Upgrade

1. Check the active PostgreSQL version:

```
psql --version
```

If you are using PostgreSQL 9.6, you can upgrade to PostgreSQL 10.

If you are already using PostgreSQL 10, you do not need to perform this migration.

2. Check the active smdba version:

```
rpm -q smdba
```

PostgreSQL 10 requires `smdba` version 1.6.2 or later.

3. Perform a database backup. For more information on backing up, see [**Administration > Backup-restore >**].

== Upgrade PostgreSQL

Always create a database backup before performing a migration.

PostgreSQL upgrades can be performed in two ways: a regular upgrade, or a fast upgrade:

A regular upgrade will create a complete copy of the database, so you will need double the existing database size of space available. Regular upgrades can take a considerable amount of time, depending on the size of the database and the speed of the storage system.

A fast upgrade only takes a few minutes, and uses almost no additional disk space. However, if a fast upgrade fails, you must restore the database from the backup. A fast upgrade reduces the risk of running out of disk space. A regular upgrade will copy the database files instead of creating hard links between the files.

PostgreSQL stores data at `/var/lib/pgsql/data/`.

Procedure: Performing a Regular Upgrade

1. Perform a database backup. For more information on backing up, see [**Administration > Backup-restore >**].
2. Start the upgrade:

```
/usr/lib/susemanager/bin/pg-migrate-96-to-10.sh
```

3. When the upgrade has successfully completed, you can safely delete the old database directory and reclaim lost disk space. The old directory is renamed to `/var/lib/pgsql/data-pg96`.

The `pg-migrate-96-to-10.sh` script performs these operations:

- Stop spacewalk services
- Shut down the running database
- Check if PostgreSQL 10 is installed and install it if necessary
- Switch from PostgreSQL 9.6 to PostgreSQL 10 as the new default
- Initiate the database migration
- Create a PostgreSQL configuration file tuned for use by Uyuni
- Start the database and spacewalk services

If the upgrade fails, the migration script will attempt to restore the database to its original state.

Procedure: Performing a Fast PostgreSQL Upgrade

1. Perform a database backup. Without a verified database backup, you must not initiate a fast upgrade. For more information on backing up, see [**Administration > Backup-restore >**].
2. Start the upgrade:

```
/usr/lib/susemanager/bin/pg-migrate-96-to-10.sh fast
```

3. When the upgrade has successfully completed, you can safely delete the old database directory and reclaim lost disk space. The old directory is renamed to **/var/lib/pgsql/data-pg96**.

= Database Migration from Version 10 to 12

This section covers upgrading the PostgreSQL database from version 10 to version 12. If you are already using PostgreSQL 12, you do not need to perform this migration. If you are using an older version, such as version 9.6, see [**Upgrade > Db-migration-10 >**].

If you want to upgrade to the latest Uyuni version, you must be using PostgreSQL version 10 or 12. You migrate to PostgreSQL version 12 after you upgraded your Uyuni Server to version 4.1.

== Prepare to Upgrade

Before you begin the upgrade, prepare your existing Uyuni Server and create a database backup.

PostgreSQL stores data at **/var/lib/pgsql/data/**.

Procedure: Preparing to Upgrade

1. Check the active PostgreSQL version:

```
psql --version
```

If you are using PostgreSQL 10, you can upgrade to PostgreSQL 12.

If you are already using PostgreSQL version 12, you do not need to perform this migration.

2. Check the active smdba version:

```
rpm -q smdba
```

PostgreSQL 10 requires **smdba** version 1.6.2 or later.

3. Perform a database backup. For more information on backing up, see [**Administration > Backup-restore >**].

== Upgrade PostgreSQL

Always create a database backup before performing a migration.

PostgreSQL upgrades can be performed in two ways: a regular upgrade, or a fast upgrade:

A regular upgrade will create a complete copy of the database, so you will need double the existing database size of space available. Regular upgrades can take a considerable amount of time, depending on the size of the database and the speed of the storage system.

A fast upgrade only takes a few minutes, and uses almost no additional disk space. However, if a fast upgrade fails, you must restore the database from the backup. A fast upgrade reduces the risk of running out of disk space. A regular upgrade will copy the database files instead of creating hard links between the files.

PostgreSQL stores data at `/var/lib/pgsql/data/`.

Procedure: Performing a Regular Upgrade

1. Perform a database backup. For more information on backing up, see [**Administration > Backup-restore >**].
2. Start the upgrade:

```
/usr/lib/susemanager/bin/pg-migrate-10-to-12.sh
```

3. When the upgrade has successfully completed, you can safely delete the old database directory and reclaim lost disk space. The old directory is renamed to `/var/lib/pgsql/data-pg10`.

The `pg-migrate-10-to-12.sh` script performs these operations:

- Stop spacewalk services
- Shut down the running database
- Check if PostgreSQL 12 is installed and install it if necessary
- Switch from PostgreSQL 10 to PostgreSQL 12 as the new default
- Initiate the database migration
- Create a PostgreSQL configuration file tuned for use by Uyuni
- Start the database and spacewalk services

If the upgrade fails, the migration script will attempt to restore the database to its original state.

Procedure: Performing a Fast PostgreSQL Upgrade

1. Perform a database backup. Without a verified database backup, you must not initiate a fast upgrade. For more information on backing up, see [**Administration > Backup-restore >**].
2. Start the upgrade:

```
/usr/lib/susemanager/bin/pg-migrate-10-to-12.sh fast
```

3. When the upgrade has successfully completed, you can safely delete the old database directory and reclaim lost disk space. The old directory is renamed to **/var/lib/pgsql/data-pg10**.

= Troubleshooting

This section contains some common problems you might encounter with Uyuni upgrades, and solutions to resolving them.

To get more information about an upgrade problem, check the migration log file. The log file is located at **/var/log/rhn/migration.log** on the system you are upgrading.

== Not Enough Disk Space

Check the available disk space before you begin migration. We recommend locating **/var/spacwalk** and **/var/lib/pgsql** on separate XFS file systems.

When you are setting up a separate file system, edit **/etc/fstab** and remove the **/var/lib/pgsql** subvolume. Reboot the server to pick up the changes.

== Retrying to Set up the Target System

If you need to retry setting up the target system, follow these steps:

1. Delete **/root/.MANAGER_SETUP_COMPLETE**.
2. Stop PostgreSQL and remove **/var/lib/pgsql/data**.
3. Set the target system hostname to match the source system hostname.
4. Check the **/etc/hosts** file, and correct it if necessary.
5. Check **/etc/setup_env.sh** on the target system, and ensure the database name is set:

```
MANAGER_DB_NAME='susemanager'
```

6. Reboot the target system.
7. Run **mgr-setup** again.

== Schema Upgrade Fails

If the schema upgrade fails, the database version check and all the other spacewalk services do not start. Run `spacewalk-service start` for more information and hints how to proceed.

You can also run the version check directly:

```
systemctl status uyuni-check-database.service
```

or

```
journalctl -u uyuni-check-database.service
```

These commands print debug information if you do not want to run the more general `spacewalk-service` command.

== The WebUI Fails to Load

Sometimes, the WebUI will not load after migration. This is usually caused by browser caching, if the new system has the same hostname and IP address as the old system. This duplication can confuse some browsers.

This issue is resolved by clearing the cache and reloading the page. In most browsers, you can do this quickly by pressing `Ctrl+F5`.

= 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. Secondly, 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 "GNU Free Documentation License".

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.