

HOWTO – Setup ESVA 2.0

Andrew MacLachlan

V1.0.1, 17/07/2008

This guide will help you to setup ESVA 2.0 to process and forward mail for your domains.

1. Introduction

1.1 Copyright

This document is © 2007 by Andrew MacLachlan. Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.1 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 can be found in Appendix A.

1.2 Disclaimer

Use the information in this document at your own risk. I disavow any potential liability for the contents of this document. Use of the concepts, examples, and/or other content of this document is entirely at your own risk.

All copyrights are owned by their owners, unless specifically noted otherwise. Use of a term in this document should not be regarded as affecting the validity of any trademark or service mark.

Naming of particular products or brands should not be seen as endorsements.

You are strongly recommended to take a backup of your system before major installation and backups at regular intervals.

1.3 Credits

A big thank you to all the clever people that have contributed to the success of ESVA over the last 14 months since v 1.7 was released. As is the nature of online forums the population tends to be transient, however that doesn't mean that the quality of advice, fixes and general discussion has suffered.

Because of the sheer amount of useful suggestions that have made their way into this release I can't thank everyone personally, however special thanks has to go to the guys who made it all possible with the excellent software upon which ESVA is based on:

Julian Field – MailScanner

Steve Freegard – MailWatch for MailScanner

Also a mention to everyone on the MailScanner and Mailwatch mailing lists.

From the ESVA community I'd like to thank everyone, but special thanks to Dave Waldron who was instrumental in getting the momentum going again for the 2.0 release.

Any comments or suggestions should be posted to the official ESVA forum at:

<http://www.global-domination.org/forum/>

2. Prerequisites

- VMware Server 1.0.2 (for Windows or Linux) or ESX v3.x
- Minimum 12GB free disk space
- Minimum 512 MB unreserved memory
- A basic grasp of VMware principles and terminology
- Internet DNS mx records configured for your domain(s) pointing toward ESVA (or the public interface of your firewall, with appropriate port forwarding configured)

3. Default Usernames and Passwords

| <u>Resource</u> | <u>Username</u> | <u>Password</u> |
|----------------------|-----------------|-----------------|
| Console/Webmin | root | password |
| MailWatch web portal | admin | password |

Important

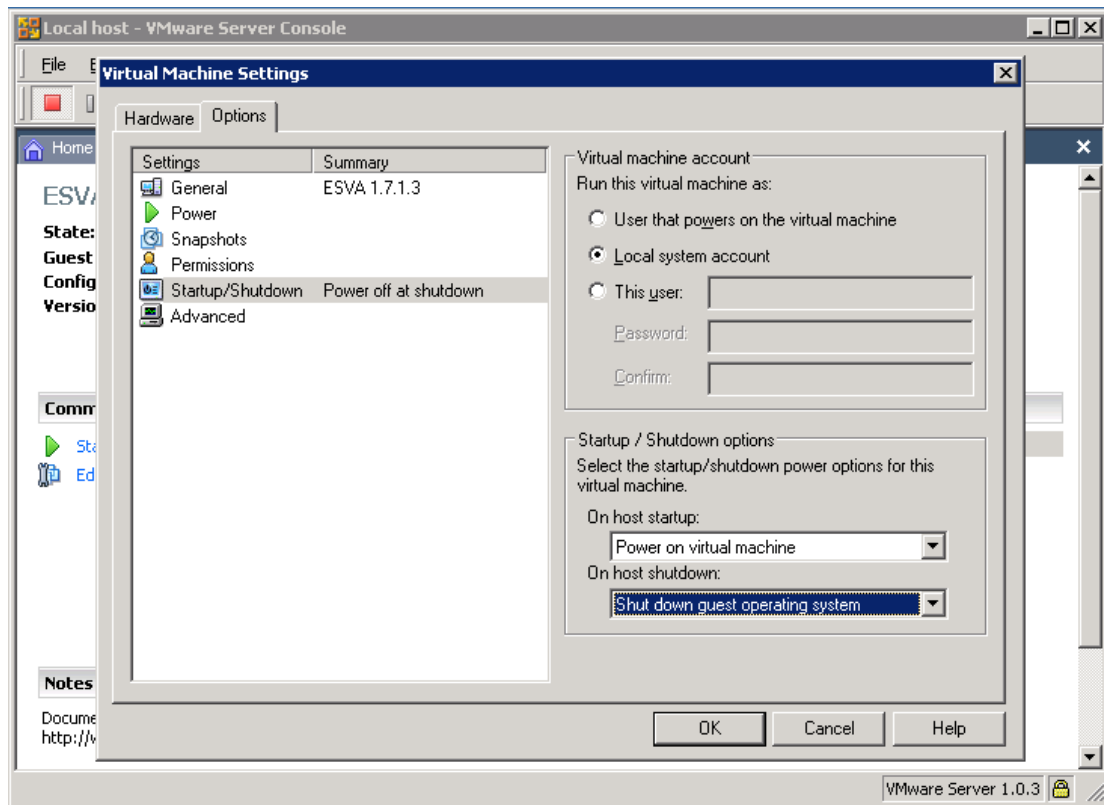
All passwords should be changed from the defaults before ESVA is exposed to untrusted networks (e.g. Internet)

5. Setup

5.1 VMware host Setup

Once you have downloaded, unzipped and registered ESVA with your VMware software, you should configure ESVA to start automatically at host start-up and to shut down gracefully at system shut down. In VMware Server 1.x (For Windows) you will find these options by navigating through VM > Settings, then choosing the options tab. Select Startup/Shutdown and configure the options as displayed below.

Once this is configured, click OK and power ESVA on.



5.2 Initial set-up

- Login as root
- Type `esva-configure` to enter the quick setup program and answer the questions. For clarification of what some of the questions mean, and sample answers, please see the table below.

| Prompt | Description |
|--|--|
| Keyboard (GUI) | The correct keyboard layout for your location |
| Timezone (menu) | The correct Timezone for your location |
| Host set to UTC time? | Is the VMware host set to use UTC time? |
| IP Address | The IP Address you want your ESVA to use |
| Netmask | The netmask in dotted format – e.g 255.255.255.0 |
| Gateway | Default gateway |
| Hostname | The name of your ESVA – use a fully qualified name. e.g. mail-gw.yourdomain.com. This should be the same as the Internet DNS A record. |
| Organisation Name | A short name without spaces. E.g. your-domain |
| Organisation Long Name | A longer name. Spaces are OK. E.g. Your Domain PLC |
| Organisation Mailserver | The mailservier that ESVA forwards scanned (clean) mail to. This can be either a name or an IP address. |
| Email address for system messages | ESVA sends regular messages to keep you informed of any problems and log summaries etc. This should be a real monitored mailbox. |
| Watermark Secret | A random string of alpha-numeric characters. This should be consistent across all ESVAs in your enterprise. |
| Maximum number of MailScanner child processes | The default of 2 should be kept unless you have a very busy system (more than 2000 messages/hour). Increasing this beyond 3 will require additional memory to be assigned to your ESVA: 5 children: 600MB, 1 processor core 6-10 children: 1024MB memory, 2 processor cores. |
| What is your two-letter IANA country code? | The two letter code assigned to your country. The full list can be found at http://www.iana.org/domains/root/db/# |
| Regular user account | A username that can login to ESVA remotely via SSH session. Defaults to the username portion of the email address supplied for system messages. |
| Regular user password | The password for the regular user account. |
| Root password | Your new root password. Avoid using the @ symbol in the password as webmin doesn't like it. |
| Country Name | The same IANA country code used earlier |
| State or province | Your state or province name |
| Locality Name | Your town or city |
| Organization Name | Your organisation's name |
| Organization Unit | A dot (period) is usually appropriate here |
| Common Name | The fully qualified name of your ESVA – as entered earlier |
| Email Address | The same email address entered earlier for system messages to be sent to. |

After the last question is answered the changes are committed and your ESVA will reboot. As soon as the Virtual Machine has rebooted it is ready to start processing mail.

If you make a mistake during the setup process, press `ctrl-c` to exit the setup program. You can then restart the program.

Unlike previous versions of ESVA, `esva-configure` can be run many times without issue.

5.3 MailWatch set-up

Point your browser at <http://the-ip-address-or-name-you-configured-esva-to-use>

5.3.1 Securing the admin account

Sign in using username admin and the default password (listed in section 3)

Click on Tools/Links, then User Management

Edit the admin user

Change the password for admin, and for extra safety change the username as well.

Click update when done. You will need to login with the new details.

5.3.2 Creating Domain Administrator accounts

Domain Administrator accounts can manage the messages for a given email domain (e.g. global-domination.org). This means that the Domain Administrator can create new user accounts for that domain as well as manage spam, white/black lists and create reports for all users in the domain.

Login to MailWatch as the admin account secured in section 5.3.1.

Click on Tools/Links, then User Management and finally click on New User.

Complete the form, supplying real names and email addresses (This is where MailWatch decides which domain the user will be administrator of). Make sure that Domain Administrator is the User Type.

Click on the Create button when the fields have been filled in correctly.

5.3.3 Creating User Accounts

User accounts have the ability to manage only their own spam, whitelists and blacklists.

Login to MailWatch as the admin account secured in section 5.3.1 or as the appropriate Domain Administrator account created in 5.5.2.

Click on Tools/Links, then User Management and finally click on New User.

Complete the form, supplying real names and email addresses (This is how MailWatch decides which messages belong to a particular user). Make sure that User is the User Type.

Click on the Create button when the fields have been filled in correctly.

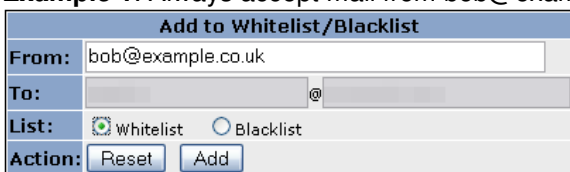
5.3.4 Whitelisting and Blacklisting within MailWatch

There are many types of circumstances where you would need to use Whitelisting and Blacklisting.

It is important to understand the precedence of how these are processed: If a message matches both the whitelist and blacklist, the whitelist wins and the message will be delivered. Additionally, the options you see on the Lists screen will vary depending on the type of logged-in user (User, Domain Admin, or System Admin)

To modify your whitelists and blacklists, use the "Lists" text link in the upper left portion of the MailWatch interface. It's best to illustrate how this works by examples.

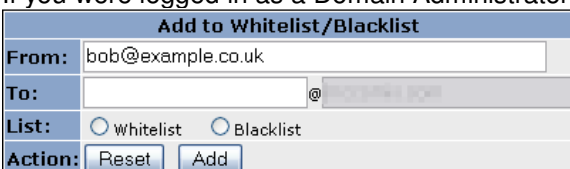
Example 1: Always accept mail from bob@example.co.uk illustrated at various user privilege levels.



| Add to Whitelist/Blacklist | |
|----------------------------|--|
| From: | bob@example.co.uk |
| To: | <input type="text"/> @ <input type="text"/> |
| List: | <input checked="" type="radio"/> Whitelist <input type="radio"/> Blacklist |
| Action: | <input type="button" value="Reset"/> <input type="button" value="Add"/> |

Notice that the To: fields are grey-ed out. This is the case if you are logged in as a normal user.

If you were logged in as a Domain Administrator, it would appear like so:



| Add to Whitelist/Blacklist | |
|----------------------------|---|
| From: | bob@example.co.uk |
| To: | <input type="text"/> @ <input type="text"/> |
| List: | <input type="radio"/> Whitelist <input type="radio"/> Blacklist |
| Action: | <input type="button" value="Reset"/> <input type="button" value="Add"/> |

In this case, the Domain Administrator may choose to always whitelist bob@example.co.uk to everyone in his domain by adding this to the whitelist.

Finally, you can whitelist bob@example.co.uk system-wide. Note that in many cases you wouldn't see this, but understanding that the use of the word "default" as the To: field allows this type of system-wide rule.

| Add to Whitelist/Blacklist | |
|----------------------------|--|
| From: | bob@example.co.uk |
| To: | default @ |
| List: | <input checked="" type="radio"/> Whitelist <input type="radio"/> Blacklist |
| Action: | <input type="button" value="Reset"/> <input type="button" value="Add"/> |

Example 2: Always reject mail from spammy@badhost.net, illustrated at various user privilege levels. User view: Note again that the To: field cannot be modified by individual users. Mail from this address will be blocked, but only blocked when sending to this user.

| Add to Whitelist/Blacklist | |
|----------------------------|--|
| From: | spammy@badhost.net |
| To: | @ |
| List: | <input type="radio"/> Whitelist <input checked="" type="radio"/> Blacklist |
| Action: | <input type="button" value="Reset"/> <input type="button" value="Add"/> |

This is the same view, but a Domain Administrator can block mail from this user across the entire domain.

| Add to Whitelist/Blacklist | |
|----------------------------|--|
| From: | spammy@badhost.net |
| To: | @ |
| List: | <input type="radio"/> Whitelist <input checked="" type="radio"/> Blacklist |
| Action: | <input type="button" value="Reset"/> <input type="button" value="Add"/> |

Similar to Example 1, this might not be of much actual use in practice, but the system will be blocking an email address systemwide by putting in a blacklist entry at the System Administrator user level.

| Add to Whitelist/Blacklist | |
|----------------------------|--|
| From: | spammy@badhost.net |
| To: | default @ |
| List: | <input type="radio"/> Whitelist <input checked="" type="radio"/> Blacklist |
| Action: | <input type="button" value="Reset"/> <input type="button" value="Add"/> |

Understanding MailWatch Lists when used with Filters.

Filters in MailWatch allow a MailWatch user to have access in MailWatch to mail messages that might be to an additional alias which he controls. For example, user joe@company.com has an alias of info@company.com. MailWatch needs to know this so that Joe can actually manipulate (release from quarantine) mail that was sent to the info@ address. In MailWatch, the System Administrator can set up a "filter" for joe@company.com allowing him to also see info@company.com.

It is important to understand that MailWatch, in the current version, does not automatically apply whitelist and blacklist rules against addresses that you specify via a filter.

For example, joe@company.com has filter info@company.com. Joe's business advertising advisor at advert@example.co.uk. Because of the nature of what they're sending back and forth, they decide it's best to whitelist each other to avoid false positives. So Joe@company.com has a whitelist entry of advert@example.co.uk. However, a message was sent to info@company.com, and was subsequently caught as spam because the joe@company.com whitelist did not apply. This is a known issue and there are some hacks in the forums to work around this issue.

5.3.5 Greylist options

When you click on the Greylist menu, a sub-menu opens below the main menu bar:

| | | | | | | |
|-------------------|---|-------------|---------------|-----------------|--------------|----------------|
| Recent Messages | Lists | Quarantine | Reports | Tools/Links | Greylist | Logout |
| Greylisted | AWL Addresses | AWL Domains | White Domains | White Addresses | Grey Domains | Grey Addresses |
| Greylisted | - Messages that are waiting to pass greylisting | | | | | |
| AWL | - Auto White List. These addresses or domains have passed greylisting tests and are now trusted, so won't be affected by greylisting again. | | | | | |
| White | - Manually Whitelisted. These addresses or domains will never be affected by greylisting tests. | | | | | |
| Grey | - Manually Greylisted. These addresses or domains will always be subjected to greylisting tests. | | | | | |

A brief explanation of the terminology is included in the main screen (above).

All details displayed in the following lists can be sorted by clicking on the relevant column heading.

5.3.5.1 Greylisted

This screen lists all addresses that are awaiting verification. If an address isn't validated within 24 hours it will be automatically removed from this list. It is worthwhile keeping an eye on this list to capture any addresses or domains that are valid, yet don't resend (this is common with website forum notifications – notably the VMware VMTN forums). Addresses in this list can be manually whitelisted or deleted by clicking on the appropriate link. It is possible to delete all entries before a specific time via the form at the bottom of the page.

5.3.5.2 AWL Addresses

Once an address has been validated, it is automatically whitelisted and appears in this list. Addresses in this list can be deleted by clicking on the delete link to the right of each address.

At the bottom of the screen, there is a form to manually add individual addresses to the AWL. For the fields, follow the example below. The Source field is for the source IP address in either class c notation (first 3 octets - xxx.xxx.xxx – this will allow messages to be sent from any host within that class c address range) or class d notation (full IP address – xxx.xxx.xxx.xxx)

You will probably notice that some of the automatically whitelisted addresses are class c and some are class d – this is determined by SQLgrey and is a sign of how much it trusts an address – A class d is less trusted, and probably comes from dynamic address space or doesn't have a matching reverse lookup.

Please note that any spam that survives greylisting will be added to the AWL. In the screenshot below the bottom address was a spam which was detected by and dealt with by MailScanner. If successful spam comes from a particular host or domain regularly, consider adding them to the Grey Domains or Grey Addresses lists to force a retry on every message sent, doubling the effort required for them to send to your domains.

| Recent Messages | Lists | Quarantine | Reports | Tools/Links | Greylist | Logout |
|--|------------------------------------|----------------|---------------------|---------------------|------------------------|----------------|
| Greylisted | AWL Addresses | AWL Domains | White Domains | White Addresses | Grey Domains | Grey Addresses |
| Auto Whitelist Addresses | | | | | | |
| Sender name | Sender domain | Source | First seen | Last seen | | |
| customer_service | vmware.com | 66.35.234 | 2007-05-19 21:07:47 | 2007-05-19 21:08:14 | Delete | |
| jiveadmin | vmware.com | 66.35.226 | 2007-05-19 22:04:31 | 2007-05-19 22:04:31 | Delete | |
| woau | frontiernet.net | 68.155.245.254 | 2007-05-19 21:23:17 | 2007-05-19 21:33:09 | Delete | |
| Delete '-undef-' entries | | | | | | |
| Add to whitelist | | | | | | |
| Sender name: | <input type="text"/> | | | | | |
| Sender domain: | <input type="text"/> | | | | | |
| Source (class c or d): | <input type="text"/> | | | | | |
| | <input type="button" value="Add"/> | | | | | |

5.3.5.3 AWL Domains

Once a domain has sent messages from multiple source addresses to multiple destination addresses, it will be automatically whitelisted (and will appear in this list) – all senders from that domain will be trusted to send to all recipients, as long as the source remains the same (class c or d).

As for the AWL Addresses list, any domain can be deleted manually and entries can be manually added as long as you have the correct source address and class.

5.3.5.4 White Domains

The domain that is referred to here is the domain in the FQDN determined by reverse lookup, not the senders domain name. For example, company yyy sends all their mail through their ISPs (zzz) smarthost. The mail from address will be yyy.com, but the reverse lookup on the mail server sending the message is zzz.com. If you decide to trust all hosts that resolve to zzz.com hostnames, you can manually add zzz.com to the white domain list.

| | | | | | | |
|---|---------------|-------------|---------------|-----------------|--------------|----------------|
| Recent Messages | Lists | Quarantine | Reports | Tools/Links | Greylist | Logout |
| Greylisted | AWL Addresses | AWL Domains | White Domains | White Addresses | Grey Domains | Grey Addresses |
| White Domains | | | | | | |
| Add a domain | | | | | | |
| gmail.com delete | | | | | | |
| googlemail delete | | | | | | |
| mailcontrol.com delete | | | | | | |
| vmware.com delete | | | | | | |
| yahoo.com delete | | | | | | |
| <input type="text"/> <input type="button" value="Add"/> | | | | | | |

Of course any domain can be deleted as well.

5.3.5.5 White Addresses

This is similar to the White Domains list, however is for specific servers rather than entire domains.

5.3.5.6 Grey Domains

If you get a lot of spam from a particular domain or subdomain, you can force all hosts on that domain to be permanently greylisted, meaning they won't be automatically whitelisted.

| | | | | | | |
|---|---------------|-------------|---------------|-----------------|--------------|----------------|
| Recent Messages | Lists | Quarantine | Reports | Tools/Links | Greylist | Logout |
| Greylisted | AWL Addresses | AWL Domains | White Domains | White Addresses | Grey Domains | Grey Addresses |
| Grey Domains | | | | | | |
| Add a domain | | | | | | |
| int.bellsouth.net delete | | | | | | |
| <input type="text"/> <input type="button" value="Add"/> | | | | | | |

5.3.5.7 Grey Addresses

The same as for Grey Domains, but for individual hosts.

6. Migration

Depending on how large your quarantine is, you might need to follow the procedure to extend your /var filesystem documented at <http://www.global-domination.org/pdf/howto-esva-bigquarantine.pdf> first. If you followed that procedure for the 1.x ESVA you will also need to extend your new 2.0 ESVA by following the same procedure if you are using VMware Server 1.x. If you are using VMware Server 2.x, you can follow the procedure at <http://www.global-domination.org/forum/viewtopic.php?t=1041>. If you are using ESX server, you can use vmkfstools to extend the virtual disks then follow the procedure above.

Important

Before you start, backup your ESVAs by shutting them down and tarring or zipping them up (Don't use a snapshot if you need to extend the disk). This will be your rollback if it all goes wrong!
Please read this procedure in full before proceeding with any of the steps!
This procedure requires use of the command line interface.
All databases on the destination server will be over-written by the imported databases.

From ESVA 1.6

On the source ESVA (1.6)

Don't use this procedure if you are migrating from version 1.7 or 2.0

1. Log in using an SSH client (putty or similar) as root
2. Enter the following commands:

```
service MailScanner stop
cd /var/spool/MailScanner
mkdir /var/tmp/export
tar -cvzf /var/tmp/export/quarantine.tgz ./quarantine/
cd /var/tmp/export
sa-learn --backup>bayes.txt
mysqldump mailscanner>mailscanner.sql
cd /var/tmp
tar -cvzf export.tgz ./export/
```

3. Using WinSCP or similar, copy export.tgz to your desktop or somewhere else temporarily.
4. Shutdown the source ESVA (1.6)

On the destination ESVA (2.0)

1. Power on your configured ESVA 2.0
2. Log in using an SSH client (putty or similar) as the username created during the setup process, then switch to the root account (type `su -l` and enter the root password when prompted)
3. Run the following command:

```
esva-import-1
```

4. Using WinSCP or similar, copy export.tgz to /var/tmp
5. Run the following command (this might take a long time, and will overwrite all the information already in the mailwatch database on your new ESVA...):

```
esva-import-2
```

6. Your ESVA should now have all the MailScanner database information and quarantined messages from your old ESVA, as well as your old Bayes database migrated to the MySQL database used in ESVA 2.0
7. You should now log out of the puTTY and WinSCP clients.

From ESVA 1.7 or 2.0

On the source ESVA

Run the following commands as root:

```
service MailScanner stop
cd /var/spool/MailScanner
mkdir /var/tmp/export
tar cvzf /var/tmp/export/quarantine.tgz ./quarantine/
cd /var/tmp/export
mysqldump mailscanner>mailscanner.sql
mysqldump FuzzyOcr>FuzzyOcr.sql
mysqldump sa_bayes>sa_bayes.sql
mysqldump sqlgrey>sqlgrey.sql
cd /var/tmp
tar cvzf export.tgz ./export/
```

Use winscp to copy /var/tmp/export.tgz off the source ESVA
Shut the source ESVA down

On the destination ESVA

Run the following commands as root:

```
esva-import-1
```

Copy export.tgz to /var/tmp/ on the destination ESVA and run the following commands:

```
cd /var/tmp
tar -xvzf export.tgz
rm -f export.tgz
cd export
mysql mailscanner<mailscanner.sql
mysql FuzzyOcr<FuzzyOcr.sql
mysql sa_bayes<sa_bayes.sql
mysql sqlgrey<sqlgrey.sql
cd /var/spool/MailScanner
tar -xvzf /var/tmp/export/quarantine.tgz
sed -i 's/#PermitRootLogin/PermitRootLogin/g' /etc/ssh/sshd_config
service sshd restart
service MailScanner start
```

8. Firewall Settings

- Regular tcp SMTP port (25) (bi-directional)
- Razor2 (tcp ports 2703 and 7 outbound)
- Pyzor (udp port 24441 outbound)
- DCC (udp port 6277 outbound)
- DNS (port 53 outbound)
- HTTP (TCP port 80 bi-directional)
- HTTPS (TCP port 443 inbound)
- Optionally, SSH (TCP port 22 Inbound)

If you are using an enterprise class firewall such as Cisco PIX or Checkpoint, you might find the following link useful:

DCC: <http://www.rhyolite.com/anti-spam/dcc/firewall.html>

Appendix A - GNU Free Documentation License

GNU Free Documentation License

Version 1.2, November 2002

Copyright (C) 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.

If 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.