SUSE Linux Enterprise Server

Hardening SUSE Linux Enterprise Server with OpenSCAP

To audit and harden SUSE Linux Enterprise Server (SLES), administrators use the OpenSCAP framework and the `SCAP Security Guide` to automate configuration checks, vulnerability scanning and compliance tracking. This guide details infrastructure preparation, core package installation, policy scanning and automated system remediation using native shell scripts or Ansible playbooks.

Publication Date: October 08, 2026

Contents

1 What are SCAP and OpenSCAP? 3

2 What is the SCAP Security Guide? 3

3 The benefits of using OpenSCAP and the `SCAP Security Guide` 4

4 Preparing your infrastructure before hardening SLES 4

5 Installing OpenSCAP and the `SCAP Security Guide` on SLES 6

6 What are the key components of the SCAP framework? 7

7 SCAP Security Guide content and directories 7

8 Customizing the SCAP Security Guide 12

9 Scanning for security vulnerabilities using OpenSCAP 13

10 How to automatically remediate non-compliant configurations? 24

11 Related topics 32

12 Legal notice 32

13 GNU Free Documentation License 32

Important: Disclaimer

SUSE seeks to provide customers with quick and easy guides that can assist them in maintaining security compliance. Implementation of the settings contained within this guide without its prior testing in a non-operational environment is highly discouraged. The developers of these profiles and documentation have made reasonable efforts to ensure overall compliance. They assume no responsibility for its use by other parties, and make no guarantee, expressed or implied, about its quality, reliability or any other characteristic.

1 What are SCAP and OpenSCAP?

SCAP stands for `Security Content Automation Protocol`. It is a framework of specifications that support automated configuration, vulnerability scanning, and policy compliance evaluation of systems deployed in an organization. SCAP is maintained by the National Institute of Standards and Technology (NIST). This framework standardizes how vulnerabilities and security configurations are communicated both to machines and humans.

OpenSCAP is a collection of open source tools that implement the SCAP framework for Linux. The suite received the SCAP 1.2 certification by NIST in 2014.

2 What is the SCAP Security Guide?

The `SCAP Security Guide` (SSG) is an open source project that provides machine-readable security policies for Linux systems. It translates established security benchmarks, such as Security Technical Implementation Guides from the Defense Information Systems Agency (DISA) and Center for Internet Security (CIS) benchmarks, into SCAP content that can be automatically applied and verified. The `SCAP Security Guide` delivers XCCDF checklists, OVAL checks, and ready-to-use remediation scripts in the form of Ansible playbooks and Bash scripts.

3 The benefits of using OpenSCAP and the SCAP Security Guide

Automated auditing

The OpenSCAP tools, together with the `SCAP Security Guide`, can be used for auditing your system in an automated way.

Authoritative guidance

The `SCAP Security Guide` implements security guidelines recommended by respected authorities.

Machine-readable format

These security guidelines are transformed into a machine-readable format, which then can be used by OpenSCAP and other tools.

4 Preparing your infrastructure before hardening SLES

Before installation and hardening, you must prepare your IT infrastructure for the implementation of the SCAP Security Guide. Execute the following sequential steps:

1. Create an inventory of the hosts on which the SCAP Security Guide will be installed.
2. Create an inventory of IT and business services that will be in the scope of the installation.
3. Split the inventory into a few groups, considering that the configuration of hosts belonging to a group will be identical.
4. Select the standard or profile you plan to implement. For example, you can use the Defense Information Systems Agency STIG, the Payment Card Industry Data Security Standard (PCI-DSS) or the Health Insurance Portability and Accountability Act (HIPAA).
5. For each group member, create a list of rules and recommendations you plan to implement. You should consider the following:
    - Preconditions necessary for some of the rules
    - Configuration parameters for each recommendation, if they exist

- Recommendations to be applied manually
- Recommendations to be applied automatically
- Recommendations to be excluded
- Additional security controls or measures will be implemented to address excluded recommendations

6. Create a test environment that simulates your environment. Use it as a reference before implementing the technology in your real environment. You should consider the following:

   - The remediation has to be executed more than twice, because:
     - The recommendations are executed in alphabetical order.
     - Between some recommendations, there are dependencies.
     - The operating system needs to be restarted after each pass.
   - A 100% hardening is impossible, and you have to specify an acceptable level of risk for members of each group.

   ### Note

   The acceptable level is several rules that will show the result “not pass” in case of an audit. Document these rules and apply additional security controls to compensate for them.

7. Use the test environment to test new patches and new updates of SSG.
8. In case of an error during the remediation, try the following:

   - Apply the rule manually.
   - Exclude the rule using tailoring and use an additional security control instead.
   - Register a bug, providing details about the SSG version, logs from execution and steps performed by you.

9. Create an implementation plan covering your production environment.
10. Create backups.

5 Installing OpenSCAP and the SCAP Security Guide on SLES

To use the OpenSCAP tools and the SCAP Security Guide for hardening your target system by scanning and remediating vulnerabilities, install the following core packages:

- openscap-utils
- scap-security-guide

```
> sudo zypper install openscap-utils scap-security-guide
```

Note

These packages are dependencies for other optional packages discussed below.

Optionally, install the following packages:

- scap-workbench: This package provides the SCAP Workbench graphical utility to perform common oscap tasks.

  ### Note

  The scap-workbench package, being a GUI software, is available only for desktop installations of SLES.

- ssg-apply: When used along with SCAP Workbench, this package helps you conveniently apply a tailoring file for customized hardening.

```
> sudo zypper install scap-workbench ssg-apply
```

Tip: Security best practice for SCAP Workbench

As a security best practice, avoid installing application software such as SCAP Workbench on the target system that you plan to harden. Instead, install SCAP Workbench on a client machine and apply the hardening on the target system, while maintaining an air gap before the target system is connected to a potentially insecure network.

6 What are the key components of the SCAP framework?

SCAP consists of the following important components, which interact with each other:

Open Vulnerability and Assessment Language (OVAL)

An XML format for testing the presence of a specific state.

Extensible Configuration Checklist Description Format (XCCDF)

An XML format that specifies security checklists, benchmarks and configuration documentation. The XCCDF file includes a benchmark as a set of different profiles related to different groups. Each group is a set of rules that has OVAL definitions. Each profile is related to different good practices such as STIG, HIPAA, PCI DSS, or ANSSI.

Common Platform Enumeration (CPE)

A structured naming scheme to identify information technology systems, platforms and software packages. It is maintained by NIST and NDV. The naming scheme consists of the following elements: `cpe:/part:vendor:product:version:update:edition:language`.

DataStreams (DS)

An XML format that packs different SCAP components (CPE, XCCDF, OVAL) into a single file. It can be used to distribute SCAP content over the network. The DataStreams files are useful because they include everything you need when you want to harden and audit your SUSE Linux system.

Common Configuration Enumeration (CCE)

Unique identifiers for security-related system configuration issues.

7 SCAP Security Guide content and directories

SUSE ships the SSG toolset in the `scap-security-guide` package. It contains the latest set of security policies for Linux systems. The `SCAP Security Guide` is maintained upstream in the ComplianceAs-Code (https://github.com/ComplianceAsCode/) repository.

After you have installed the package, the SSG security content and the related files are available in your system from the following directories:

7.1 Overview of files and directories

`/usr/share/xml/scap/ssg/content/`

Contains the SSG security content. It consists of several *What are the key components of the SCAP framework?*, which are all based on XML. All XML files in that directory are named according to the SCAP component and to the product they apply to.

You can view all available security policies by getting a list of datastream files:

```
> ls -l /usr/share/xml/scap/ssg/content/ssg-*-ds.xml
```

`/usr/share/doc/scap-security-guide/guides/`

Contains profiles for different hardening policies in a human-readable format. They describe the profiles that are included in the DataStream files. Each profile is a guide on securing your operating system to ensure compliance with a regulation.

The guides usually have the following structure:

- Short description
- Profile title. For example: *DISA STIG for SUSE Linux Enterprise Server 15*
- Profile ID. For example: *xccdf_org.ssgproject.content_profile_stig*
- Revision history. Information about the current version and status of the profile. For example: *xccdf_org.ssgproject.content_profile_stig*
- Platforms (in CPE notation). Lists the products or systems to which the profile applies. For example: *cpe:/o:suse:linux_enterprise_server:15*
- A table of contents
- A checklist that consists of groups (and subgroups) with rules

  Each rule consists of a short description, the rationale behind the rule, a severity (low, medium or high) and a unique identifier in the `Common Configuration Enumeration (CCE)` format. The CCE number for each rule is provided to SUSE by NIST.

  Each rule also lists references to different good practices. For example, the rule known by the unique identifier `CCE-83289-9` in STIG has a reference to a specific good practice `A.12.4.1` in ISO/IEC 27001:2013.

If remediation options exist for a rule, they are listed in different formats.

`/usr/share/scap-security-guide`

Contains subdirectories with fix scripts that can be used to remediate the target system in case a vulnerability is found during a scan. Fix scripts are available in the following two formats: Shell scripts (`bash/*.sh`) and Ansible snippets (`ansible/*.yml`).

7.2 SCAP Security Guide profiles

The `SCAP Security Guide` contains multiple profiles. The applicable profiles are specific to the individual product and its underlying development stream.

They are maintained and hosted in the following repository: https://github.com/ComplianceAs-Code/content/tree/master/products/sle15/profiles

After the installation of the `scap-security-guide` package, human-readable versions of the profiles are available in your file system in `/usr/share/doc/scap-security-guide/guides`.

To list the guides for each profile in an HTML format, run the following command:

```
> ls -l /usr/share/doc/scap-security-guide/guides/ssg*.html
```

You can then see the guide related to a specific profile in your Web browser. For example, to see the SLES 15 STIG profile using the Mozilla Firefox Web browser, run the following command:

```
> firefox
/usr/share/doc/scap-security-guide/guides/ssg-sle15-guide-stig.html
```

Alternatively, find the same content online as static HTML pages: https://complianceas-code.github.io/content-pages/guides/index.html

In the online versions, scroll to the appropriate product and select one of the available profiles.

7.2.1 Viewing information on SSG profiles

Each security policy can have multiple profiles, which provide policies implemented according to specific security baselines. Every profile can select different rules and use different values. You can list these profiles using the following command format:

```
> oscap info --fetch-remote-resources
/usr/share/xml/scap/ssg/content/ssg-OPERATING-SYSTEM-TYPE-OF-FILE.xml (1)
```

1. In the above command:

    - Replace *`OPERATING-SYSTEM`* with `sle15`
    - Replace *`TYPE-OF-FILE`* with either `ds` or `xccdf`

For example, you can view information about the `ds` files of SLES 15 using the following command:

```
> oscap info
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

The following technical terms appear in the **`oscap info`** output for `ds` and `xccdf` files:

- **Document type.** Describes the file format. Common types include XCCDF, OVAL, Source Data Stream and Result Data Stream.
- **Checklist version.** The XCCDF version only shown for XCCDF files. Common values are `1.1` and `1.2`.
- **Imported.** The date the file was imported for use with OpenSCAP. As OpenSCAP uses the local file system and has no proprietary database format, the imported date is the same as the file modification date.
- **Status.** The XCCDF Benchmark status. Common values include `accepted`, `draft`, `deprecated`, and `incomplete`. Please refer to the XCCDF specification for details. This is only shown for XCCDF files.
- **Generated.** The date the file was created. This date is shown for XCCDF files and Checklists, and is sourced from the XCCDF Status element.
- **Profiles.** Available profile IDs that you can use for the `--profile` command-line attribute with the **`oscap xccdf eval`** command.
- **Checklists.** Lists available checklists incorporated in the Data Stream that you can use for the `--benchmark-id` command-line attribute with the **`oscap xccdf eval`** command. Also, each checklist has detailed information displayed.

For example, for STIG profiles, the following is relevant: `xccdf_org.ssgproject.content_profile_stig`.

7.2.2 Supported profiles

For SLES 15, the following profiles are **supported** by SUSE:

- ANSSI-BP-028 (enhanced)
- ANSSI-BP-028 (high)
- ANSSI-BP-028 (intermediary)
- ANSSI-BP-028 (minimal)
- DISA STIG for SUSE Linux Enterprise Server 15
- Hardening for Public Cloud Image of SUSE Linux Enterprise Server for SAP Applications 15
- Health Insurance Portability and Accountability Act
- PCI DSS v4 Control Baseline for SUSE Linux Enterprise Server 15
- Public Cloud Hardening for SUSE Linux Enterprise Server 15

Note: Text-based list as updated information on supported profiles

If there is a mismatch between the supported profiles listed above and the profiles shown in the image below, refer to the text-based list above as the updated information. The image below is for illustration only, and may not reflect the updated list of supported profiles.

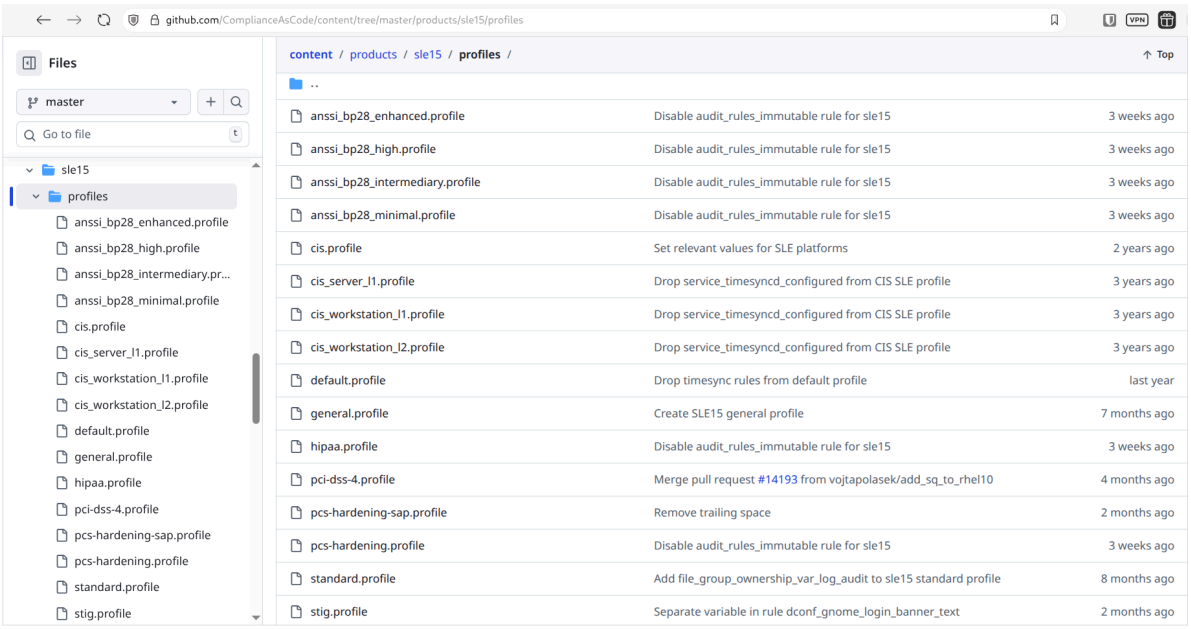

FIGURE 1: SCAP SECURITY GUIDE PROFILES FOR SLES 15

8 Customizing the SCAP Security Guide

To customize the SCAP Security Guide for policies and profiles of your choice, perform the following steps:

1. Run the SCAP Workbench GUI software installed earlier.

```
> sudo scap-workbench
```

2. Select `SLe15` as the variant for the target system, then select *Load Content*.

3. Using the *Profile* drop-down list, select a profile with the desired policy, then select *Customize*.

4. Set a new ID for your custom profile. Set the ID in the following format: `xccdf_`*`REVERSE-DNS`*`_profile_`*`REST-OF-THE-ID`*. For example, `xccdf_org.`*`mycorporation`*`_profile_`*`server`*.

> **Warning**
>
> You cannot change the ID of the custom profile later, using the SCAP Workbench.

5. Deselect the rules that you do not want in the custom profile. For example, you can deselect the following rule: `Record Events that Modify the System's Discretionary Access Controls - chmod`.

6. To save the changes to the profile, select *OK*. The main guide window is displayed again.

   - To save only the customization, select *Select customization file* › *Open* › *Save customization only*. This creates a small file containing only the changes made to the original profile, and is called a customization or *tailoring* file. The advantage of this approach is that when a new version of the profile is available, you can simply apply your tailoring to it, instead of customizing it from scratch.

   - Alternatively, you can save the entire modified content in a directory. In that case, select the file, followed by *Save all>Into a directory*.

7. To use the customization file with the **`oscap`** command-line tool, use the `--tailoring-file` *`NAME-OF-TAILORING-FILE`* option. For example:

```
> sudo oscap xccdf eval \
--profile xccdf_org.ssgproject.content_profile_stig_customized \
--report report_sle15_stig.html \
--tailoring-file ssg-sle15-ds-tailoring.xml \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

9 Scanning for security vulnerabilities using OpenSCAP

9.1 Targets to scan

The content provided by the `SCAP Security Guide` can be used to scan the following targets for vulnerabilities:

- bare-metal machines
- virtual machines
- virtual machine images

- containers
- container images

Automated checks help to identify the target and to select only the rules that make sense for this specific target. For example, checks for separate partitions make sense for bare-metal machines but not for containers.

9.2 Tools for scanning

Note

Before using the tools described in this section, ensure that you have installed them as described in *Section 5, "Installing OpenSCAP and the* `SCAP Security Guide` *on SLES"*, as they are interdependent.

Depending on your setup and the target to scan (remote or local), you can use either of the following tools:

oscap

A command-line interface that can be used to scan local machines. Both the `openscap-utils` and `scap-security-guide` packages need to be installed on the local machine.

To understand the basic usage of **`oscap`**, run it with the **`-h`** option:

```
> oscap -h

  oscap

  OpenSCAP command-line tool

  Usage: oscap [options] module operation [operation-options-and-arguments]

  Common options:
    --verbose <verbosity_level>   - Turn on verbose mode at specified verbosity
 level.
                                    Verbosity level must be one of: DEVEL, INFO,
 WARNING, ERROR.
    --verbose-log-file <file>     - Write verbose information into file.

  oscap options:
    -h --help                     - show this help
    -q --quiet                    - quiet mode
    -V --version                  - print info about supported SCAP versions
```

```
Commands:
    ds - Data stream utilities
    oval - Open Vulnerability and Assessment Language
    xccdf - eXtensible Configuration Checklist Description Format
    cvss - Common Vulnerability Scoring System
    cpe - Common Platform Enumeration
    cve - Common Vulnerabilities and Exposures
    cvrf - Common Vulnerability Reporting Framework
    info - Print information about a SCAP file.
```

To understand `oscap` in greater detail, read its man pages by running **`man oscap`**.

oscap-ssh

A command-line interface that can be used to scan a remote machine via SSH with an interface resembling the **`oscap`** tool. On the local machine, the package `openscap-utils` needs to be installed. On the remote machine, the `openscap-utils` package needs to be installed.

To understand the basic usage of **`oscap-ssh`**, run it with the **`-h`** option:

```
> oscap -h

oscap-ssh -- Tool for running oscap over SSH and collecting results.

Usage:

$ oscap-ssh user@host 22 info INPUT_CONTENT
$ oscap-ssh user@host 22 xccdf eval [options] INPUT_CONTENT

Only source data streams are supported as INPUT_CONTENT!

supported oscap xccdf eval options are:
  --profile
  --tailoring-file
  --tailoring-id
  --cpe (external OVAL dependencies are not supported yet!)
  --oval-results
  --results
  --results-arf
  --report
  --skip-valid
  --skip-validation
  --fetch-remote-resources
  --local-files
  --progress
  --datastream-id
  --xccdf-id
```

```
    --benchmark-id
    --remediate

  $ oscap-ssh user@host 22 oval eval [options] INPUT_CONTENT

  supported oscap oval eval options are:
    --id
    --variables
    --directives
    --results
    --report
    --skip-valid
    --skip-validation
    --datastream-id
    --oval-id

  $ oscap-ssh user@host 22 oval collect [options] INPUT_CONTENT

  supported oscap oval collect options are:
    --id
    --syschar
    --variables
    --skip-valid
    --skip-validation

  specific option for oscap-ssh (must be first argument):
    --sudo

  To supply additional options to ssh/scp, define the SSH_ADDITIONAL_OPTIONS
variable
  For instance, to ignore known hosts records, define SSH_ADDITIONAL_OPTIONS='-o
StrictHostKeyChecking=no -o UserKnownHostsFile=/dev/null'

  specific option for oscap-ssh (must be first argument):

  See `man oscap` to learn more about semantics of these options.
```

To understand `oscap-ssh` in greater detail, read its man pages by running **`man oscap-ssh`**.

SCAP Workbench

SCAP Workbench is a graphical user interface for OpenSCAP. You can use it for convenience instead of using `oscap`. For example, you can use SCAP Workbench for scanning a single machine, either local or remote (via SSH).

To use SCAP Workbench, both the `scap-workbench` and `scap-security-guide` packages need to be installed on the local machine. On the remote machine, the `openscap-utils` package needs to be installed.

To start SCAP Workbench, run the following command:

```
> scap-workbench
```

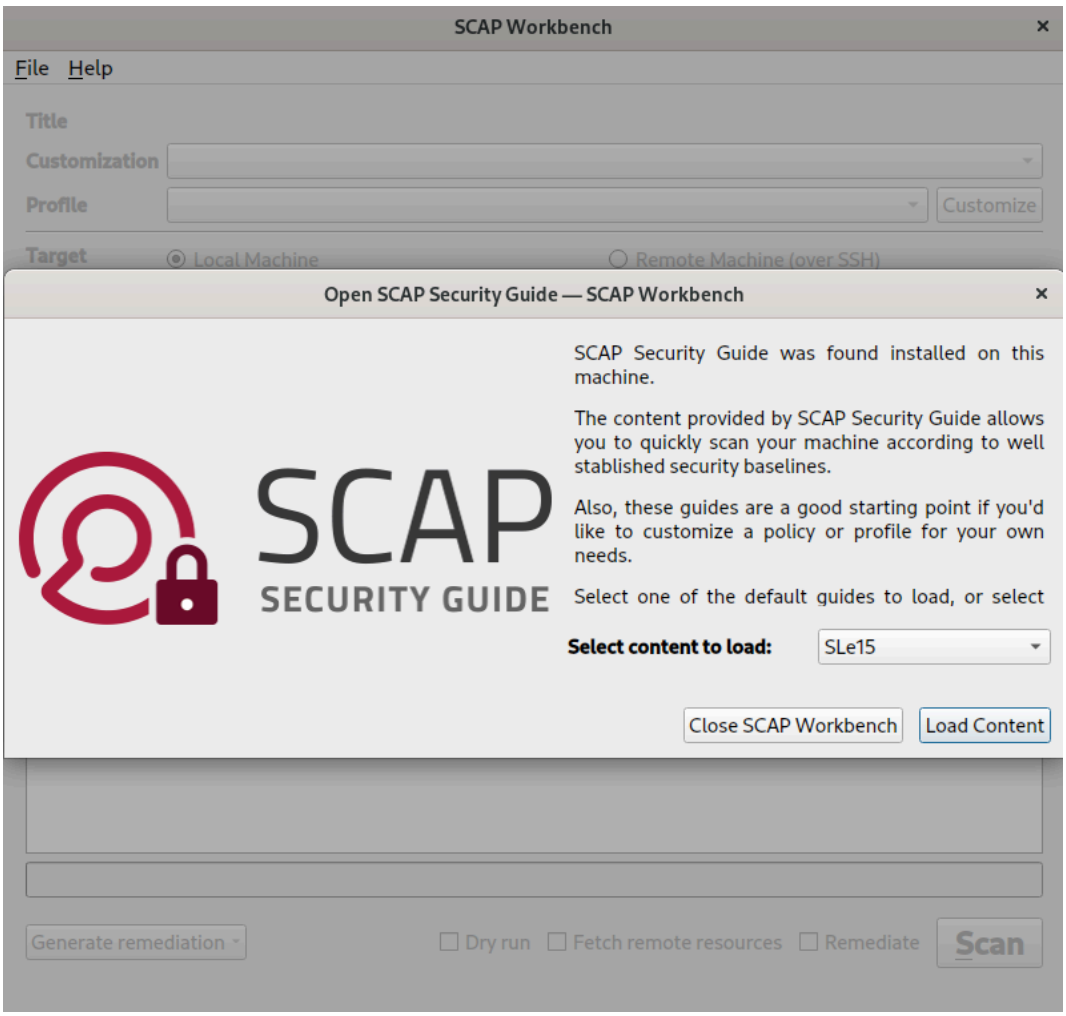

FIGURE 2: SCAP WORKBENCH

Although not recommended, you can invoke and perform certain basic operations by using SCAP Workbench as a command-line tool. To know more, read its man page by running **`man scap-workbench`**.

9.3 Scanning a SLES system

You can scan your system locally with **`oscap`** for vulnerability issues according to a certain profile. You can save the results in XML format and generate an HTML report.

EXAMPLE 1: SCANNING SLES WITH OSCAP

```
> oscap xccdf eval ❶ \
    --profile stig ❷ \
    --results /tmp/results.xml ❸ \
    --report /tmp/report.html ❹ \
    /usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml ❺
```

❶ Calls the **`oscap xccdf`** module and tells it to perform an evaluation (vulnerability scan).

❷ Specifies the profile to use, in this case, `stig`.

❸ Saves the results of the evaluation to */tmp/results.xml*.

❹ Generates an HTML report called */tmp/report.html* in addition to the results in XML.

❺ Specifies the `SCAP Security Guide` policy file to use. In this example, we use a policy file in the `DataStream` format. To list all available policies, run: **`ls -1 /usr/share/xml/scap/ssg/content/ssg-*-ds.xml`**. For more information about a particular policy, run **`oscap info`** on the file.

The evaluation process usually takes a few minutes, depending on the number of selected rules.

9.4 Evaluating with rules

For each rule, we have the following fields:

- **Rule.** For example, `Install AIDE`
- **Rule ID.** For example, `xccdf_org.ssgproject.content_rule_package_aide_installed`.

After determining the security policy and profile, use **`oscap xccdf eval`** to perform an evaluation against them. For example, to evaluate the profile `xccdf_org.ssgproject.content_profile_stig` and generate an HTML report, you can use the following command format:

```
> sudo oscap xccdf eval \
--profile xccdf_org.ssgproject.content_profile_stig \
--report report_sle15_stig.html \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

To evaluate with a specific rule, you can specify the *Rule ID* using the `--rule` command option. For example, you can evaluate only with the rule *xccdf_org.ssgproject.content_rule_package_aide_installed*:

```
> sudo oscap xccdf eval \
```

```
--profile xccdf_org.ssgproject.content_profile_stig \
--report report_sle15_stig.html \
--rule xccdf_org.ssgproject.content_rule_package_aide_installed \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

To evaluate *without* a specific rule, you can specify to skip the *Rule ID* using the `--skip-rule` command option. For example, you can evaluate without the rule *xccdf_org.ssgproject.content_rule_package_aide_installed*:

```
> sudo oscap xccdf eval \
--profile xccdf_org.ssgproject.content_profile_stig \
--report report_sle15_stig.html \
--skip-rule xccdf_org.ssgproject.content_rule_package_aide_installed \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

9.5 Using external or remote resources for scanning

SCAP content may reference external resources. For example, the SCAP Security Guide uses an external OVAL file to check whether the system is up to date and patched against known security vulnerabilities. However, OpenSCAP can handle remote resources differently, based on the options used while invoking the **`oscap`** command. In addition, you can use strategies like downloading specific remote resources in advance and pointing the OpenSCAP tool towards the downloaded resources while invoking it.

9.5.1 Default warning for remote resources by OpenSCAP while performing evaluation

While evaluating SCAP content with external resources, the OpenSCAP tool displays a **warning**. For example, OpenSCAP displays the following warning while performing the default evaluation of a system based on the SCAP Security Guide:

```
> oscap xccdf eval \
--profile xccdf_org.ssgproject.content_profile_stig \
--results ssg-sle15-xccdf-stig-results.xml \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml

WARNING: Datastream component 'scap_org.open-scap_cref_pub-projects-security-oval-
suse.linux.enterprise.15-
patch.xml.bz2' points out to the remote 'https://ftp.suse.com/pub/projects/security/oval/
suse.linux.enterprise.
15-patch.xml.bz2'. Use '--fetch-remote-resources' option to download it.
```

```
WARNING: Skipping 'https://ftp.suse.com/pub/projects/security/oval/
suse.linux.enterprise.15-patch.xml.bz2' file
which is referenced from datastream

WARNING: Skipping ./pub-projects-security-oval-suse.linux.enterprise.15-patch.xml.bz2
 file which is referenced
from XCCDF content
```

The following sections describe certain strategies to force OpenSCAP to fetch remote resources in real time, or download them in advance and use them for evaluation and scanning the system.

9.5.2 Fetching remote resources for evaluation

If you trust your local content and the remote content it references, you can use the `--fetch-remote-resources` option to automatically download it when invoking the OpenSCAP tool.

```
> oscap xccdf eval \
--fetch-remote-resources \
--profile xccdf_org.ssgproject.content_profile_stig \
--results ssg-sle15-xccdf-stig-results.xml \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml

Downloading: https://ftp.suse.com/pub/projects/security/oval/suse.linux.enterprise.15-
patch.xml.bz2 ... ok

--- Starting Evaluation —
...
```

However, if access to the Internet is unavailable at the time of evaluation, or is considered a security risk, you can instruct OpenSCAP to use local files instead of remote resources.

9.5.3 Downloading and saving remote resources locally for evaluation

On systems without Internet access, or in security-sensitive deployments where OpenSCAP cannot connect to the Internet, download the remote content using other tools and save it locally. You can then pass it to OpenSCAP as a local file using the `--local-files` option, instead of the `--fetch-remote-resources` option.

For example, to prevent OpenSCAP from accessing the Internet but still use the patch file https://ftp.suse.com/pub/projects/security/oval/suse.linux.enterprise.15-patch.xml.bz2, perform the following procedure.

1. *(Optional)* Create a directory for storing the downloaded remote resources.

```
> mkdir ~/scap-files (1)
```

(1) Directory to store downloaded remote resources. If you have identified a suitable directory, skip this step.

2. Download the remote resource and save it as a local file.

```
> wget -O ~/scap-files/pub-projects-security-oval-suse.linux.enterprise.15-
patch.xml.bz2 (1) \
https://ftp.suse.com/pub/projects/security/oval/suse.linux.enterprise.15-
patch.xml.bz2 (2)
```

(1) The path to the locally saved file.

(2) The remote resource to be downloaded and saved locally.

Note

In this example, the name of the local file is **not** arbitrary. Notice the following information in the SCAP source data stream file available at `/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml`:

```
> cat /usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml | \
grep -n "scap_org.open-scap_cref_pub-projects-security-oval-
suse.linux.enterprise.15-patch.xml.bz2"

17:          <cat:uri name="pub-projects-security-oval-
suse.linux.enterprise.15.xml" uri="#scap_org.open-scap_cref_pub-projects-
security-oval-suse.linux.enterprise.15-patch.xml.bz2"/>
25:      <ds:component-ref id="scap_org.open-scap_cref_pub-projects-
security-oval-suse.linux.enterprise.15-patch.xml.bz2" xlink:href="https://
ftp.suse.com/pub/projects/security/oval/suse.linux.enterprise.15-
patch.xml.bz2"/>
```

3. Run the evaluation using the local files downloaded earlier from the remote source.

```
> oscap xccdf eval \
 --local-files ~/scap-files \
 --profile xccdf_org.ssgproject.content_profile_stig \
 --results ssg-sle15-xccdf-stig-results.xml \
 /usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

```
 WARNING: Using local file '~/scap-files/pub-projects-security-oval-
suse.linux.enterprise.15-patch.xml.bz2'
 instead of 'https://ftp.suse.com/pub/projects/security/oval/
suse.linux.enterprise.15-patch.xml.bz2'

 --- Starting Evaluation —
```

Tip

Download and use the specific files that are relevant for your SLES product version, and avoid more generic ones. Being specific about the purpose and the files helps reduce the usage of server resources such as the processor, memory, storage and bandwidth. In addition, smaller file sizes also reduce the time required to complete the evaluation. For example, if you are interested only in SLES 15 SP5, use the file available at https://ftp.suse.com/pub/projects/security/oval/suse.linux.enterprise.15-sp5-patch.xml.bz2.

4. *Optionally*, you can generate an HTML report from the XML results file.

```
> oscap xccdf generate report ssg-sle15-xccdf-stig-results.xml >
ssg-sle15-xccdf-stig-report.html
```

Tip

You can generate an HTML report directly using the **`oscap xccdf eval --report`** option, but separating the scan and the HTML report generation leads to less usage of server resources.

9.6 Scanning and auditing systems using OVAL files

Using the OVAL content files for SLES products, you can assess your SLES systems and generate reports on the RPM package names and versions that are known to be affected by security issues in published CVEs.

The OVAL data provided by SUSE includes the following:

- The patch-style OVAL data, which expresses all security updates on a patch level. These can include multiple CVEs per patch.
- The vulnerability OVAL data, which expresses security vulnerabilities on a CVE level.

For detailed information on OVAL support provided by SUSE, refer to https://www.suse.com/support/security/oval/.

You can download OVAL files provided by SUSE from https://ftp.suse.com/pub/projects/security/oval/. As a best practice for scanning and auditing systems using OVAL files, perform the following procedure:

1. *(Optional)* Create a directory for downloading and storing remote resources.

```
> mkdir ~/oval-files (1)
```

(1) Directory to store downloaded remote resources such as OVAL patch files. If you have identified a suitable directory, skip this step.

2. Download the remote resource and save it as a local file.

```
> wget -O ~/oval-files/suse.linux.enterprise.15-patch.xml.bz2(1) \
https://ftp.suse.com/pub/projects/security/oval/suse.linux.enterprise.15-
patch.xml.bz2(2)
```

(1) The path to the locally saved file.

(2) The remote resource to be downloaded and saved locally.

3. Run the evaluation using the local files downloaded earlier from the remote source.

```
> oscap oval eval \
--results sle15-oval-results.xml \
~/oval-files/suse.linux.enterprise.15-patch.xml.bz2

Definition oval:org.opensuse.security:def:45435: false
Definition oval:org.opensuse.security:def:45434: false
Definition oval:org.opensuse.security:def:45433: false
Definition oval:org.opensuse.security:def:45432: false
Definition oval:org.opensuse.security:def:45431: false
Definition oval:org.opensuse.security:def:45430: false
Definition oval:org.opensuse.security:def:45429: false
...

Evaluation done.
```

Tip

Download and use the specific files that are relevant for your SLES product version, and avoid more generic ones. Being specific about the purpose and the files helps reduce the usage of server resources such as the processor, memory, storage and bandwidth. In addition, smaller file sizes also reduce the time required to complete the evaluation. For example, if you are interested only in SLES 15 SP5, use the file available at https://ftp.suse.com/pub/projects/security/oval/suse.linux.enterprise.15-sp5-patch.xml.bz2.

4. *Optionally*, you can generate an HTML report from the XML results file.

```
> oscap oval generate report sle15-oval-results.xml >
sle15-oval-report.html
```

Tip

You can generate an HTML report directly using the **`oscap oval eval --report`** option, but separating the scan and the HTML report generation leads to less usage of server resources.

10 How to automatically remediate non-compliant configurations?

Beyond scanning and reporting, the `SCAP Security Guide` security profiles can automatically remediate the target system by applying necessary fixes.

Important: Automatic remediation not always available

Automatic remediation is *not* offered in case the automatic application of a fix is too dangerous to be enforced in a running target system.

10.1 OpenSCAP remediation process

OpenSCAP allows to automatically remediate target systems that have been found in a non-compliant state. This requires an XCCDF file with instructions. The overall process is as follows:

1. The **oscap** command-line tool performs a system scan.
2. Each rule that fails is marked as a candidate for remediation.
3. Within the XCCDF file, **oscap** then searches for an appropriate <xccdf:fix> element, resolves it, prepares the environment, and executes the fix script. The fix scripts can be either Bash `*.sh` files or Ansible playbook `*.yml` files.
4. After the execution of the script, the respective rule is evaluated again to check if the fix was successful.

All results of the remediation are stored in an output XCCDF file.

10.2 OpenSCAP remediation options

For remediating a target system with **oscap**, you have the following options:

Remediation on the fly

You can remediate a target system on the fly, while you are scanning it. In this case, evaluation and remediation are performed as a part of a single command. For details, see *Section 10.4.1, "Remediating SLES (on the fly)"*.

Remediation after scanning

You can remediate a target system after you have scanned it. In the first step, the system is only evaluated, and the results are stored in the XCCDF results file. In the second step, **oscap** executes the fix scripts and verifies the result. For details, see *Section 10.4.2, "Remediating SLES (after scanning)"*.

Review mode

The review mode allows to save remediation instructions to a file for further review. The remediation content is not executed during this operation. For details, see *Section 10.4.4, "Storing SLES remediation instructions for review"*.

10.3 Remediating for a specific profile using shell scripts

For simple remediation of a profile without any condition, you can use the shell scripts that are shipped with the SCAP Security Guide.

1. Find the shell scripts that perform remediation without any condition:

```
> ls -l /usr/share/scap-security-guide/bash/
```

   The names of the scripts follow the format: `sle15-script-NAME-OF-PROFILE.sh`.
   The supported profiles are as follows: `stig`, `anssi_bp28_xxx`, `hipaa`, `pci-dss-4`, and `pcs-hardening`.

Note

The standard profile is officially *not supported*.

2. Understand the format of the shell scripts and the rules within. In the scripts, each rule or recommendation maintains the following format:

   - Starts with `# BEGIN fix (CURRENT-NUMBER/TOTAL-NUMBER-OF-RULES) for RULE-ID`
   - Ends with `# END fix for RULE-ID`.

Note: Exceptions to the rule format

Certain rules contain a line ending with `IS MISSING!` in between the `BEGIN` and `END` lines for a rule block. These rules do not have a remediation part. You need to do remediation manually to apply them.

3. Although the recommended approach for excluding rules from remediation is to use tailoring, you can also do it manually if there are bugs, or for tests. In that case, open the intended script with a text editor and comment out the necessary lines between `BEGIN` and `END` for a rule block.

4. Make the script executable:

```
> sudo chmod +x sle15-script-NAME-OF-PROFILE.sh
```

5. Run the script:

```
> ./sle15-script-NAME-OF-PROFILE.sh
```

10.4 Remediating a SLES system with `oscap`

The following examples show how to scan and remediate SLES locally with **`oscap`** to comply with a certain profile.

10.4.1 Remediating SLES (on the fly)

To remediate a system (on the fly), you can use a combination of `--eval` and `--remediate` options of the **`oscap`** command. In this case, the system is first scanned (audited), and then the command attempts to fix the system. During the execution of the audit, you will see the status after each rule as `pass`, `fail`, or `not applicable`. During the execution of the remediation, you will see the status as `fixed` or `error` after some of the rules.

EXAMPLE 2: REMEDIATING SLES SYSTEMS (ON THE FLY)

```
> sudo oscap xccdf eval --remediate❶ \
--profile stig❷ \
--results /tmp/results.xml❸ \
--report /tmp/report.html❹ \
--skip-rule xccdf_org.ssgproject.content_rule_accounts_authorized_local_users❺ \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml❻
```

```
> sudo reboot
```

❶ Calls the **`oscap xccdf`** module and tells it to perform an evaluation plus a remediation of the target system in one go.

❷ Specifies the profile to use, in this case, `stig`.

❸ Saves the results of the evaluation to */tmp/results.xml*.

❹ Saves the report of the evaluation to */tmp/report.html*.

❺ Rules that you want to skip.

❻ Specifies the `SCAP Security Guide` policy file to use for SLES 15.

In the resulting */tmp/results.xml* file, the first `TestResult` element shows the result of the scan *before* the remediation. The second `TestResult` element shows the result of the scan *after* applying the remediation. In the second `TestResult` element, if the result of a rule is `fixed`, this means that the fix was successfully applied, and this rule now passes evaluation. If the result of a rule is `error`, this means that the remediation for this rule was not successful, and the rule still does not pass evaluation.

Warning: Usage of the `--skip-rule` option

In the above example, the `--skip-rule` option is optional. However, it is necessary to use it if you did not change the variable `var_accounts_authorized_local_users_regex`. Otherwise, you will not be able to do a **`sudo`** after reboot.

10.4.2 Remediating SLES (after scanning)

In this example, we first execute a scan and then run the remediation as the next step.

EXAMPLE 3: REMEDIATING SLES (AFTER SCANNING)

1. ```
   > oscap xccdf eval ❶ \
         --profile stig ❷ \
         --results /tmp/results.xml ❸ \
         /usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml ❹
   ```

   ❶ Calls the **`oscap xccdf`** module and tells it to perform an evaluation.

   ❷ Specifies the profile to use, in this case, `stig`.

   ❸ Saves the results of the evaluation as an XCCDF file to */tmp/results.xml*.

   ❹ Specifies the `SCAP Security Guide` policy file to use. In this example, we use a policy file in the `DataStream` format that applies to SLES 15. To list all available policies, run: **`ls -1 /usr/share/xml/scap/ssg/content/ssg-*-ds.xml`**. For more information about a particular policy, run **`oscap info`** on the file.

   During this step, the system is only evaluated, and the results are stored in a `TestResult` element in */tmp/results.xml*.

2. ```
   > oscap xccdf remediate ❶ \
       --results /tmp/results.xml ❷ \
       /tmp/results.xml ❸
   ```

   ❶ Calls the **`oscap xccdf`** module and tells it to perform a remediation.

   ❷ Saves the results of the remediation to */tmp/results.xml*.

   ❸ Uses the */tmp/results.xml* XCCDF file from the first step (evaluation) as input file.

   During this step, the results file from the first step is used as input for the **`oscap`** command. You can safely store the results from the second step in the same file that you use as the input file, */tmp/results.xml*. During this run, **`oscap`** creates a new `xccdf:TestResult` element in the

file. The new element is based on the previous one and inherits all the data. The newly created `xccdf:TestResult` element differs only in the `rule-result` elements which failed in the first run. Only for those is the remediation executed.

10.4.3 Remediating systems using **oscap** and scripts

To remediate a system, you have to generate a script that will fix the system. You have to decide in advance the profile and type of the script—bash or Ansible.

Note: Evaluate the system before remediation

Before running the examples in this section, ensure that you have evaluated the system using the **oscap xccdf eval** commands.

EXAMPLE 4: REMEDIATING SLES SYSTEMS USING oscap AND BASH

```
> sudo oscap xccdf generate fix --profile stig --fetch-remote-resources \
--fix-type bash --output GENERATED-BASH-REMEDIATION-SCRIPT-NAME.sh \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

EXAMPLE 5: REMEDIATING SLES SYSTEMS USING oscap AND ANSIBLE

```
> sudo oscap xccdf generate fix --profile stig --fetch-remote-resources \
--fix-type ansible --output GENERATED-ANSIBLE-REMEDIATION-SCRIPT-NAME.yml \
/usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml
```

After running any of the above commands, you can run the generated script to remediate the system.

10.4.4 Storing SLES remediation instructions for review

You can also run **oscap** in review mode to store remediation instructions to a file for further review. During this operation, the remediation content is *not* executed. The following shows how to generate remediation instructions in the form of a shell script:

EXAMPLE 6: STORING SLES REMEDIATION INSTRUCTIONS FOR REVIEW

```
> oscap xccdf generate fix❶ \
     --template urn:xccdf:fix:script:sh❷ \
     --profile stig❸ \
     --output my-remediation-script.sh❹ \
```

```
    /usr/share/xml/scap/ssg/content/ssg-sle15-ds.xml ❺
```

❶ Calls the **`oscap xccdf`** module and tells it to generate a file with remediation instructions.

❷ Specifies the template to use, in this case, a shell script.

❸ Specifies the profile to use, in this case, `stig`.

❹ Specifies the file to which the remediation instructions are written.

❺ Specifies the `SCAP Security Guide` policy file to use. In this example, we use a policy file in the `DataStream` format that applies to SLES 15. To list all available policies, run: **`ls -1 /usr/share/xml/scap/ssg/content/ssg-*-ds.xml`**. For more information about a particular policy, run **`oscap info`** on the file.

10.5 Remediating a SLES system with Ansible

You can use the Ansible playbooks provided by the `SCAP Security Guide` to remediate a local system.

The `ansible` package is available from `SUSE Package Hub`. Register your SLES system and enable the `SUSE Package Hub` module. Then install the package with **`sudo zypper in ansible`**.

EXAMPLE 7: REMEDIATING SLES 15 WITH ANSIBLE

For example, to remediate your system using the STIG Ansible playbook for SLES 15 provided by the `SCAP Security Guide`, use the following command.

Warning: System configuration changes

The following command alters the configuration of your system immediately. Make sure to test this thoroughly in a non-production system first.

```
> ansible-playbook -i "localhost," -c local \
/usr/share/scap-security-guide/ansible/sle15-playbook-stig.yml
```

After the playbook has finished, you are prompted to log in to your system, which is now compliant with the chosen policy.

10.6 Remediating for a specific profile using Ansible

For simple remediation of a profile without any condition, you can use the Ansible playbooks that are shipped with the SCAP Security Guide.

1. List the Ansible playbooks that are shipped with the SCAP Security Guide.

```
> ls -l /usr/share/scap-security-guide/ansible/
```

   The file names are in the following format: `sle15-playbook-NAME-OF-PROFILE.yml`.

2. Create a file `ansible_inventory.yml` and include the following configuration snippet:

```
all:
  hosts:
    localhost:
  vars:
    ansible_connection: local
```

3. Then run the following command:

```
> sudo ansible-playbook -i ansible_inventory.yml
sle15-playbook-NAME-OF-PROFILE.yml (1)
```

   (1) Substitute `NAME-OF-PROFILE` with any of the supported profiles, as seen in the file names within the directory `/usr/share/scap-security-guide/ansible/`.

   To skip some of the rules during the execution, use the `--tag` option. You can find the tag of a specific rule by searching for the rule's tag in the playbook file. For example, to skip some rules for SLES, run the following command:

```
> sudo ansible-playbook -i ansible_inventory.yml sle15-playbook-NAME-OF-PROFILE.yml
 \
--tags "package_aide_installed,aide_build_database"
```

Note

You might need to repeat the steps above more than twice, because of the following reasons:

- Some of the rules require a restart of the system to take effect.
- The rules are executed in alphabetical order.

11 Related topics

- Check out the `SCAP Security Guide` pages online at https://www.open-scap.org/security-policies/scap-security-guide/.
- For general instructions on how to use the `SCAP Security Guide`, see the README in https://github.com/ComplianceAsCode/content/.
- Find the *OpenSCAP User Manual* at https://static.open-scap.org/openscap-1.2/oscap_user_manual.html.

12 Legal notice

Copyright© 2006– 2026 SUSE LLC and contributors. All rights reserved.

Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or (at your option) version 1.3; with the Invariant Section being this copyright notice and license. A copy of the license version 1.2 is included in the section entitled “GNU Free Documentation License”.

For SUSE trademarks, see https://www.suse.com/company/legal/. All other third-party trademarks are the property of their respective owners. Trademark symbols (®, ™ etc.) denote trademarks of SUSE and its affiliates. Asterisks (*) denote third-party trademarks.

All information found in this book has been compiled with utmost attention to detail. However, this does not guarantee complete accuracy. Neither SUSE LLC, its affiliates, the authors, nor the translators shall be held liable for possible errors or the consequences thereof.

GNU Free Documentation License

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 non-commercially. 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 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 non-commercially, 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 https://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.