Managing I/O and CPU Scheduling with the RT Kernel

I/O and CPU scheduling using the RT kernel in SUSE Linux Enterprise Server optimizes resource allocation to ensure deterministic execution for latency-sensitive tasks. By configuring block device schedulers, assigning process I/O priorities with `ionice` and isolating CPU cores using `systemd` and `taskset`, administrators prevent disk starvation and latency spikes. This coordination guarantees predictable response times and maximum system throughput for mission-critical real-time applications.

Prerequisites

- Installed RT kernel on SUSE Linux Enterprise Server
- Access to a command-line terminal with `systemd`, `taskset`, `chrt` and `ionice` available

Publication Date: 05 Nov 2026

Contents

1 How does I/O scheduling work? 3

2 How to manage process I/O priorities with **`ionice`**? 3

3 Changing the block device I/O scheduler 4

4 Tuning block device I/O scheduler parameters 5

5 CPU partitioning and affinity 6

6 Managing CPU shielding with `systemd`, **`taskset`** and **`chrt`** 7

7 Multi-queue I/O schedulers and key parameters 8

8 For more information 9

9 Legal Notice 9

A GNU Free Documentation License 10

1 How does I/O scheduling work?

Handling I/O requests predictably is critical for deterministic performance in real-time systems. High CPU availability yields limited benefits if tasks stall while awaiting disk access.

The Linux storage subsystem organizes process disk access into three distinct scheduling classes:

Real-time (class 1)

Grants highest priority for disk access. Requests in this class are served before any other class. Within the real-time class, priority is fine-tuned with `nice` levels from `0` (highest priority) to `7` (lowest priority).



Warning: Risk of disk bandwidth starvation

Assigning real-time I/O priorities incorrectly can deprive other system processes of disk bandwidth.

Assign real-time I/O class only to thoroughly tested critical tasks.

Best-effort (class 2)

The default scheduling class for standard system processes. Priority is derived from the process CPU `nice` value (ranging from `0` to `7`).

Idle (class 3)

Processes receive disk access only when no other process requests disk I/O. Ideal for background workloads such as logging or maintenance.

2 How to manage process I/O priorities with `ionice`?

Inspect and adjust process I/O scheduling classes and priority levels using the **`ionice`** utility.

PROCEDURE 1: SETTING I/O PRIORITIES WITH `ionice`

To view or modify process I/O scheduling attributes, perform the following steps.

1. To set the I/O scheduling class of the current shell to `idle`, run:

```
> ionice -c3 -p$$
```

2. To print the I/O scheduling class and priority of the current shell, run `ionice` without additional parameters:

```
> ionice
```

3. To set the I/O scheduling class of the process with the process ID `42` to real-time and its priority level to `2`, run:

```
> sudo ionice -c1 -p42 -n2
```

4. To start the Bash shell in the `idle` class, run:

```
> ionice -c3 /bin/bash
```

3 Changing the block device I/O scheduler

Display and change the I/O scheduler of a block device.

THE LINUX I/O SCHEDULERS

`none`

The `none` scheduler is a simple scheduler that performs no reordering of I/O requests. This scheduler is mainly used for specialized environments that run their own schedulers optimized for the used hardware, such as fast NVMe storage, storage systems or hardware RAID controllers.

`mq-deadline`

The main point of deadline scheduling is to try hard to answer a request before a given deadline. This results in good I/O for a random single I/O in real-time environments.

In principle, the `mq-deadline` scheduler uses two lists with all requests. One is sorted by block sequences to reduce seeking latencies, the other is sorted by expire times for each request. Normally, requests are served according to the block sequence, but if a request reaches its deadline, the scheduler starts to work on this request.

`bfq`

The Budget Fair Queueing (BFQ) scheduler uses a separate I/O queue for each process and tries to divide the bandwidth fairly between all requesting processes.

PROCEDURE 2: DISPLAYING AND CHANGING THE I/O SCHEDULER

1. To print the current scheduler of a block device such as `/dev/sda`, use the following command:

```
> cat /sys/block/sda/queue/scheduler
```

```
none [mq-deadline] bfq
```

The scheduler in square brackets is the active one. In this case, the scheduler for `/dev/sda` is set to `mq-deadline`.

2. To change the scheduler, write one of the listed names to `/sys/block/DEVICE/queue/scheduler`. For example, to set the I/O scheduler of the device `/dev/sda` to `none`, use the following command as `root`:

```
# echo "none" > /sys/block/sda/queue/scheduler
```

To set other variables in the `/sys/` file system, use a similar approach.

4 Tuning block device I/O scheduler parameters

Fine-tune operational parameters of active block device schedulers in `sysfs` to optimize read and write latency for real-time applications.

All schedulers, except for the `none` scheduler, have several common parameters that may be tuned for each block device. You can access these parameters with `sysfs` in the `/sys/block/DEVICE/queue/iosched/` directory. The following parameters are tunable for the respective scheduler:

THE `mq-deadline` SCHEDULER

`read_expire`

The main focus of this scheduler is to limit the start latency for a request to a given time. Therefore, for each request, a deadline is calculated from the current time plus the value of `read_expire` in milliseconds.

`write_expire`

Similar to `read_expire` for write requests.

`fifo_batch`

If a request hits its deadline, it is necessary to move the request from the sorted I/O scheduler list to the dispatch queue. The variable `fifo_batch` controls how many requests are moved, depending on the cost of each request.

`front_merges`

The scheduler normally tries to find contiguous I/O requests and merges them. There are two kinds of merges: The new I/O request may be in front of the existing I/O request (front merge), or it may follow behind the existing request (back merge). Most merges are back merges. Therefore, you can disable the front merge functionality by setting `front_merges` to `0`.

`writes_starved`

If certain read or write requests hit their deadline, the scheduler prefers the read requests by default. To prevent write requests from being postponed forever, the variable `writes_starved` controls how often read requests are preferred until write requests are preferred over read requests.

THE `bfq` SCHEDULER

`back_seek_max` **and** `back_seek_penalty`

The scheduler normally dispatches requests in a strict ascending order. When needed, it also allows small backward seeks, but it applies a penalty on them. The maximum backward sector seek is defined with `back_seek_max`, and the multiplier for the penalty is set by `back_seek_penalty`.

`fifo_expire_async` **and** `fifo_expire_sync`

The `fifo_expire_*` variables define the timeout in milliseconds for asynchronous and synchronous I/O requests. Set `fifo_expire_sync` lower than `fifo_expire_async` to prioritize synchronous requests over asynchronous operations.

`slice_idle` **and** `slice_idle_us`

Defines how long the I/O scheduler idles before servicing the next thread to maintain sequential I/O locality. `slice_idle` specifies this time in milliseconds, while `slice_idle_us` specifies it in microseconds.

5 CPU partitioning and affinity

Understand how `systemd` resource control partitions CPUs to isolate real-time workloads.

SUSE Linux Enterprise Server partitions CPUs with the cpuset controller of the unified cgroups v2 hierarchy, which you manage through `systemd`. You assign CPUs to slices, services and scopes with the `AllowedCPUs=` property. The setting can be persistent or transient.

A unit can only use the CPUs that its parent slice allows. Therefore, to dedicate CPUs to real-time workloads, restrict the primary system slices (such as `system.slice` and `user.slice`) to the remaining CPUs. The affinity of an individual process, set with **`taskset`**, is limited in the same way.

For a complete shielding procedure, refer to the article Shielding Linux Resources on SUSE Linux Enterprise Server (https://documentation.suse.com/sles/16.1/html/SLES-RT-shielding-resources/index.html).

6 Managing CPU shielding with `systemd`, **`taskset`** and **`chrt`**

Isolate real-time workloads on dedicated logical CPUs using `systemd` resource control, **`taskset`** and **`chrt`**.

PROCEDURE 3: CONFIGURING CPU ISOLATION FOR REAL-TIME WORKLOADS

To restrict general processes to CPUs `0` to `2` and dedicate CPU `3` to a critical task, perform the following steps:

1. Restrict the system slices to CPUs `0-2`. The setting is persistent. To apply it only until the next reboot, add the `--runtime` option.

```
> sudo systemctl set-property system.slice AllowedCPUs=0-2
> sudo systemctl set-property user.slice AllowedCPUs=0-2
> sudo systemctl set-property init.scope AllowedCPUs=0-2
```

2. To run an application in its own slice and restrict it to CPU `3`, use a transient scope:

```
> sudo systemd-run --scope --slice=realtime.slice --
property=AllowedCPUs=3 APPLICATION
```

3. To print the CPU affinity of the application started in the previous step, use **`taskset`** with its process ID *`PID`*:

```
> taskset -c -p PID
```

   To change the affinity, run the command as `root`. The CPU list must be within the CPUs that the slice of the process allows. In this example, that is CPU `3`:

```
> sudo taskset -c -p 3 PID
```

4. To assign the `SCHED_FIFO` real-time scheduling policy with the priority `40` to the process, run:

```
> sudo chrt --fifo -p 40 PID
```

7 Multi-queue I/O schedulers and key parameters

This section provides an overview of the available multi-queue block device I/O schedulers and their `sysfs` tuning parameters.

7.1 Available multi-queue I/O schedulers

TABLE 1: MULTI-QUEUE I/O SCHEDULERS

Scheduler	Typical use	Description
`none`	High-performance NVMe SSDs	Performs no reordering of requests and passes them directly to the hardware queues.
`mq-deadline`	SATA, SAS and traditional HDDs	The system default for most block devices. Tries to serve each request before its deadline to limit latency spikes and prevent write starvation.
`bfq`	Desktop environments and I/O-bound cgroups	Divides storage bandwidth proportionally between requesting processes or cgroups to maintain interactive responsiveness under heavy background loads.

7.2 Key `sysfs` parameters

TABLE 2: `mq-deadline` PARAMETERS

Parameter	Unit	Description
`read_expire`	Milliseconds	Deadline for starting to serve a read request.
`write_expire`	Milliseconds	Deadline for starting to serve a write request.
`fifo_batch`	Requests	Number of requests moved to the dispatch queue at once when a request hits its deadline.
`front_merges`	Flag (`0` or `1`)	Enables or disables front merges of contiguous requests.

Parameter	Unit	Description
`writes_starved`	Count	How many times read requests are preferred before a pending write request is served.

8 For more information

- The Real-Time Linux wiki: https://wiki.linuxfoundation.org/realtime/start
- `systemd` resource control (`AllowedCPUs=` and other settings): the man page of **`systemd.resource-control`** (man 5 systemd.resource-control), or the upstream documentation at https://www.freedesktop.org/software/systemd/man/systemd.resource-control.html
- The kernel documentation about control groups v2 (`Documentation/admin-guide/cgroup-v2.rst`): https://docs.kernel.org/admin-guide/cgroup-v2.html
- Detailed information about kernel control groups (https://documentation.suse.com/sles/16.1/html/SLES-kernel-control-groups/index.html)
- CPU shielding in detail: Shielding Linux Resources on SUSE Linux Enterprise Server (https://documentation.suse.com/sles/16.1/html/SLES-RT-shielding-resources/index.html)

9 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.

A 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.