Index of Documentation for People Interested in Writing and/or Understanding the Linux Kernel

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The need for a document like this one became apparent in the linux-kernel mailing list as the same questions, asking for pointers to information, appeared again and again.

Fortunately, as more and more people get to GNU/Linux, more and more get interested in the Kernel. But reading the sources is not always enough. It is easy to understand the code, but miss the concepts, the philosophy and design decisions behind this code.

Unfortunately, not many documents are available for beginners to start. And, even if they exist, there was no "well-known" place which kept track of them. These lines try to cover this lack. All documents available on line known by the author are listed, while some reference books are also mentioned.

PLEASE, if you know any paper not listed here or write a new document, send me an e-mail, and I'll include a reference to it here. Any corrections, ideas or comments are also welcomed.

The papers that follow are listed in no particular order. All are cataloged with the following fields: the document's "Title", the "Author"/s, the "URL" where they can be found, some "Keywords" helpful when searching for specific topics, and a brief "Description" of the Document.

Enjoy!

> ***Note***
>
> The documents on each section of this document are ordered by its published date, from the newest to the oldest.

Docs at the Linux Kernel tree

The DocBook books should be built with `make {htmldocs | psdocs | pdfdocs}`. The Sphinx books should be built with `make {htmldocs | pdfdocs | epubdocs}`.

- Name: **linux/Documentation**

  Author: Many.
  Location: Documentation/
  Keywords: text files, Sphinx, DocBook.
  Description: Documentation that comes with the kernel sources, inside the Documentation directory. Some pages from this document (including this document itself) have been moved there, and might be more up to date than the web version.

- Title: **The Kernel Hacking HOWTO**

  Author: Various Talented People, and Rusty.
  Location: Documentation/DocBook/kernel-hacking.tmpl
  Keywords: HOWTO, kernel contexts, deadlock, locking, modules, symbols, return conventions.

Description: From the Introduction: "Please understand that I never wanted to write this document, being grossly underqualified, but I always wanted to read it, and this was the only way. I simply explain some best practices, and give reading entry-points into the kernel sources. I avoid implementation details: that's what the code is for, and I ignore whole tracts of useful routines. This document assumes familiarity with C, and an understanding of what the kernel is, and how it is used. It was originally written for the 2.3 kernels, but nearly all of it applies to 2.2 too; 2.0 is slightly different".

- Title: **Linux Kernel Locking HOWTO**

Author: Various Talented People, and Rusty.

Location: Documentation/DocBook/kernel-locking.tmpl

Keywords: locks, locking, spinlock, semaphore, atomic, race condition, bottom halves, tasklets, softirqs.

Description: The title says it all: document describing the locking system in the Linux Kernel either in uniprocessor or SMP systems.

Notes: "It was originally written for the later (>2.3.47) 2.3 kernels, but most of it applies to 2.2 too; 2.0 is slightly different". Freely redistributable under the conditions of the GNU General Public License.

On-line docs

- Title: **Linux Kernel Mailing List Glossary**

Author: various

URL: http://kernelnewbies.org/glossary/

Date: rolling version

Keywords: glossary, terms, linux-kernel.

Description: From the introduction: "This glossary is intended as a brief description of some of the acronyms and terms you may hear during discussion of the Linux kernel".

- Title: **Tracing the Way of Data in a TCP Connection through the Linux Kernel**

Author: Richard Sailer

URL: https://archive.org/details/linux_kernel_data_flow_short_paper

Date: 2016

Keywords: Linux Kernel Networking, TCP, tracing, ftrace

Description: A seminar paper explaining ftrace and how to use it for understanding linux kernel internals, illustrated at tracing the way of a TCP packet through the kernel.

Abstract: *This short paper outlines the usage of ftrace a tracing framework as a tool to understand a running Linux system. Having obtained a trace-log a kernel hacker can read and understand source code more determined and with context. In a detailed example this approach is demonstrated in tracing and the way of data in a TCP Connection through the kernel. Finally this trace-log is used as base for more a exact conceptual exploration and description of the Linux TCP/IP implementation.*

- Title: **On submitting kernel Patches**

Author: Andi Kleen

URL: http://halobates.de/on-submitting-kernel-patches.pdf

Date: 2008

Keywords: patches, review process, types of submissions, basic rules, case studies

Description: This paper gives several experience values on what types of patches there are and how likley they get merged.

Abstract: [...]. This paper examines some common problems for submitting larger changes and some strategies to avoid problems.

- Title: **Overview of the Virtual File System**

Author: Richard Gooch.

URL: http://www.mjmwired.net/kernel/Documentation/filesystems/vfs.txt

Date: 2007

Keywords: VFS, File System, mounting filesystems, opening files, dentries, dcache.

Description: Brief introduction to the Linux Virtual File System. What is it, how it works, operations taken when opening a file or mounting a file system and description of important data structures explaining the purpose of each of their entries.

- Title: **Linux Device Drivers, Third Edition**

Author: Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman

URL: http://lwn.net/Kernel/LDD3/

Date: 2005

Description: A 600-page book covering the (2.6.10) driver programming API and kernel hacking in general. Available under the Creative Commons Attribution-ShareAlike 2.0 license.

note: You can also :ref:`purchase a copy from O'Reilly or elsewhere <ldd3_published>`.

- Title: **Writing an ALSA Driver**

Author: Takashi Iwai <tiwai@suse.de>

URL: http://www.alsa-project.org/~iwai/writing-an-alsa-driver/index.html

Date: 2005

Keywords: ALSA, sound, soundcard, driver, lowlevel, hardware.

Description: Advanced Linux Sound Architecture for developers, both at kernel and user-level sides. ALSA is the Linux kernel sound architecture in the 2.6 kernel version.

- Title: **Linux PCMCIA Programmer's Guide**

Author: David Hinds.

URL: http://pcmcia-cs.sourceforge.net/ftp/doc/PCMCIA-PROG.html

Date: 2003

Keywords: PCMCIA.

Description: "This document describes how to write kernel device drivers for the Linux PCMCIA Card Services interface. It also describes how to write user-mode utilities for communicating with Card Services.

- Title: **Linux Kernel Module Programming Guide**

Author: Ori Pomerantz.

URL: http://tldp.org/LDP/lkmpg/2.6/html/index.html

Date: 2001

Keywords: modules, GPL book, /proc, ioctls, system calls, interrupt handlers .

Description: Very nice 92 pages GPL book on the topic of modules programming. Lots of examples.

- Title: **Global spinlock list and usage**

Author: Rick Lindsley.
URL: http://lse.sourceforge.net/lockhier/global-spin-lock
Date: 2001
Keywords: spinlock.
Description: This is an attempt to document both the existence and usage of the spinlocks in the Linux 2.4.5 kernel. Comprehensive list of spinlocks showing when they are used, which functions access them, how each lock is acquired, under what conditions it is held, whether interrupts can occur or not while it is held...

- Title: **A Linux vm README**

Author: Kanoj Sarcar.
URL: http://kos.enix.org/pub/linux-vmm.html
Date: 2001
Keywords: virtual memory, mm, pgd, vma, page, page flags, page cache, swap cache, kswapd.
Description: Telegraphic, short descriptions and definitions relating the Linux virtual memory implementation.

- Title: **Video4linux Drivers, Part 1: Video-Capture Device**

Author: Alan Cox.
URL: http://www.linux-mag.com/id/406
Date: 2000
Keywords: video4linux, driver, video capture, capture devices, camera driver.
Description: The title says it all.

- Title: **Video4linux Drivers, Part 2: Video-capture Devices**

Author: Alan Cox.
URL: http://www.linux-mag.com/id/429
Date: 2000
Keywords: video4linux, driver, video capture, capture devices, camera driver, control, query capabilities, capability, facility.
Description: The title says it all.

- Title: **Linux IP Networking. A Guide to the Implementation and Modification of the Linux Protocol Stack.**

Author: Glenn Herrin.
URL: http://www.cs.unh.edu/cnrg/gherrin
Date: 2000
Keywords: network, networking, protocol, IP, UDP, TCP, connection, socket, receiving, transmitting, forwarding, routing, packets, modules, /proc, sk_buff, FIB, tags.

Description: Excellent paper devoted to the Linux IP Networking, explaining anything from the kernel's to the user space configuration tools' code. Very good to get a general overview of the kernel networking implementation and understand all steps packets follow from the time they are received at the network device till they are delivered to applications. The studied kernel code is from 2.2.14 version. Provides code for a working packet dropper example.

- Title: **How To Make Sure Your Driver Will Work On The Power Macintosh**

Author: Paul Mackerras.
URL: http://www.linux-mag.com/id/261
Date: 1999
Keywords: Mac, Power Macintosh, porting, drivers, compatibility.
Description: The title says it all.

- Title: **An Introduction to SCSI Drivers**

Author: Alan Cox.
URL: http://www.linux-mag.com/id/284
Date: 1999
Keywords: SCSI, device, driver.
Description: The title says it all.

- Title: **Advanced SCSI Drivers And Other Tales**

Author: Alan Cox.
URL: http://www.linux-mag.com/id/307
Date: 1999
Keywords: SCSI, device, driver, advanced.
Description: The title says it all.

- Title: **Writing Linux Mouse Drivers**

Author: Alan Cox.
URL: http://www.linux-mag.com/id/330
Date: 1999
Keywords: mouse, driver, gpm.
Description: The title says it all.

- Title: **More on Mouse Drivers**

Author: Alan Cox.
URL: http://www.linux-mag.com/id/356
Date: 1999
Keywords: mouse, driver, gpm, races, asynchronous I/O.
Description: The title still says it all.

- Title: **Writing Video4linux Radio Driver**

Author: Alan Cox.
URL: http://www.linux-mag.com/id/381
Date: 1999
Keywords: video4linux, driver, radio, radio devices.
Description: The title says it all.

- Title: **I/O Event Handling Under Linux**

Author: Richard Gooch.

URL: http://web.mit.edu/~yandros/doc/io-events.html

Date: 1999

Keywords: IO, I/O, select(2), poll(2), FDs, aio_read(2), readiness event queues.

Description: From the Introduction: "I/O Event handling is about how your Operating System allows you to manage a large number of open files (file descriptors in UNIX/POSIX, or FDs) in your application. You want the OS to notify you when FDs become active (have data ready to be read or are ready for writing). Ideally you want a mechanism that is scalable. This means a large number of inactive FDs cost very little in memory and CPU time to manage".

- Title: **(nearly) Complete Linux Loadable Kernel Modules. The definitive guide for hackers, virus coders and system administrators.**

Author: pragmatic/THC.

URL: http://packetstormsecurity.org/docs/hack/LKM_HACKING.html

Date: 1999

Keywords: syscalls, intercept, hide, abuse, symbol table.

Description: Interesting paper on how to abuse the Linux kernel in order to intercept and modify syscalls, make files/directories/processes invisible, become root, hijack ttys, write kernel modules based virus... and solutions for admins to avoid all those abuses.

Notes: For 2.0.x kernels. Gives guidances to port it to 2.2.x kernels.

- Name: **Linux Virtual File System**

Author: Peter J. Braam.

URL: http://www.coda.cs.cmu.edu/doc/talks/linuxvfs/

Date: 1998

Keywords: slides, VFS, inode, superblock, dentry, dcache.

Description: Set of slides, presumably from a presentation on the Linux VFS layer. Covers version 2.1.x, with dentries and the dcache.

- Title: **The Venus kernel interface**

Author: Peter J. Braam.

URL: http://www.coda.cs.cmu.edu/doc/html/kernel-venus-protocol.html

Date: 1998

Keywords: coda, filesystem, venus, cache manager.

Description: "This document describes the communication between Venus and kernel level file system code needed for the operation of the Coda filesystem. This version document is meant to describe the current interface (version 1.0) as well as improvements we envisage".

- Title: **Design and Implementation of the Second Extended Filesystem**

Author: Rémy Card, Theodore Ts'o, Stephen Tweedie.

URL: http://web.mit.edu/tytso/www/linux/ext2intro.html

Date: 1998

Keywords: ext2, linux fs history, inode, directory, link, devices, VFS, physical structure, performance, benchmarks, ext2fs library, ext2fs tools, e2fsck.

Description: Paper written by three of the top ext2 hackers. Covers Linux filesystems history, ext2 motivation, ext2 features, design, physical structure on disk, performance, benchmarks, e2fsck's passes description... A must read!

Notes: This paper was first published in the Proceedings of the First Dutch International Symposium on Linux, ISBN 90-367-0385-9.

- Title: **The Linux RAID-1, 4, 5 Code**

Author: Ingo Molnar, Gadi Oxman and Miguel de Icaza.

URL: http://www.linuxjournal.com/article.php?sid=2391

Date: 1997

Keywords: RAID, MD driver.

Description: Linux Journal Kernel Korner article. Here is its

Abstract: *A description of the implementation of the RAID-1, RAID-4 and RAID-5 personalities of the MD device driver in the Linux kernel, providing users with high performance and reliable, secondary-storage capability using software*.

- Title: **Linux Kernel Hackers' Guide**

Author: Michael K. Johnson.

URL: http://www.tldp.org/LDP/khg/HyperNews/get/khg.html

Date: 1997

Keywords: device drivers, files, VFS, kernel interface, character vs block devices, hardware interrupts, scsi, DMA, access to user memory, memory allocation, timers.

Description: A guide designed to help you get up to speed on the concepts that are not intuitevly obvious, and to document the internal structures of Linux.

- Title: **Dynamic Kernels: Modularized Device Drivers**

Author: Alessandro Rubini.

URL: http://www.linuxjournal.com/article.php?sid=1219

Date: 1996

Keywords: device driver, module, loading/unloading modules, allocating resources.

Description: Linux Journal Kernel Korner article. Here is its

Abstract: *This is the first of a series of four articles co-authored by Alessandro Rubini and Georg Zezchwitz which present a practical approach to writing Linux device drivers as kernel loadable modules. This installment presents an introduction to the topic, preparing the reader to understand next month's installment*.

- Title: **Dynamic Kernels: Discovery**

Author: Alessandro Rubini.

URL: http://www.linuxjournal.com/article.php?sid=1220

Date: 1996

Keywords: character driver, init_module, clean_up module, autodetection, mayor number, minor number, file operations, open(), close().

Description: Linux Journal Kernel Korner article. Here is its

Abstract: *This article, the second of four, introduces part of the actual code to create custom module implementing a character device driver. It describes the code for module initialization and cleanup, as well as the open() and close() system calls*.

- Title: **The Devil's in the Details**

Author: Georg v. Zezschwitz and Alessandro Rubini.
URL: http://www.linuxjournal.com/article.php?sid=1221
Date: 1996
Keywords: read(), write(), select(), ioctl(), blocking/non blocking mode, interrupt handler.
Description: Linux Journal Kernel Korner article. Here is its
Abstract: *This article, the third of four on writing character device drivers, introduces concepts of reading, writing, and using ioctl-calls*.

• Title: **Dissecting Interrupts and Browsing DMA**

Author: Alessandro Rubini and Georg v. Zezschwitz.
URL: http://www.linuxjournal.com/article.php?sid=1222
Date: 1996
Keywords: interrupts, irqs, DMA, bottom halves, task queues.
Description: Linux Journal Kernel Korner article. Here is its
Abstract: *This is the fourth in a series of articles about writing character device drivers as loadable kernel modules. This month, we further investigate the field of interrupt handling. Though it is conceptually simple, practical limitations and constraints make this an "interesting" part of device driver writing, and several different facilities have been provided for different situations. We also investigate the complex topic of DMA*.

• Title: **Device Drivers Concluded**

Author: Georg v. Zezschwitz.
URL: http://www.linuxjournal.com/article.php?sid=1287
Date: 1996
Keywords: address spaces, pages, pagination, page management, demand loading, swapping, memory protection, memory mapping, mmap, virtual memory areas (VMAs), vremap, PCI.
Description: Finally, the above turned out into a five articles series. This latest one's introduction reads: "This is the last of five articles about character device drivers. In this final section, Georg deals with memory mapping devices, beginning with an overall description of the Linux memory management concepts".

• Title: **Network Buffers And Memory Management**

Author: Alan Cox.
URL: http://www.linuxjournal.com/article.php?sid=1312
Date: 1996
Keywords: sk_buffs, network devices, protocol/link layer variables, network devices flags, transmit, receive, configuration, multicast.
Description: Linux Journal Kernel Korner.
Abstract: *Writing a network device driver for Linux is fundamentally simple---most of the complexity (other than talking to the hardware) involves managing network packets in memory*.

• Title: **Analysis of the Ext2fs structure**

Author: Louis-Dominique Dubeau.
URL: http://teaching.csse.uwa.edu.au/units/CITS2002/fs-ext2/
Date: 1994
Keywords: ext2, filesystem, ext2fs.

Description: Description of ext2's blocks, directories, inodes, bitmaps, invariants...

Published books

- Title: **Linux Treiber entwickeln**

  Author: Jürgen Quade, Eva-Katharina Kunst
  Publisher: dpunkt.verlag
  Date: Oct 2015 (4th edition)
  Pages: 688
  ISBN: 978-3-86490-288-8
  Note: German. The third edition from 2011 is much cheaper and still quite up-to-date.

- Title: **Linux Kernel Networking: Implementation and Theory**

  Author: Rami Rosen
  Publisher: Apress
  Date: December 22, 2013
  Pages: 648
  ISBN: 978-1430261964

- Title: **Embedded Linux Primer: A practical Real-World Approach, 2nd Edition**

  Author: Christopher Hallinan
  Publisher: Pearson
  Date: November, 2010
  Pages: 656
  ISBN: 978-0137017836

- Title: **Linux Kernel Development, 3rd Edition**

  Author: Robert Love
  Publisher: Addison-Wesley
  Date: July, 2010
  Pages: 440
  ISBN: 978-0672329463

- Title: **Essential Linux Device Drivers**

  Author: Sreekrishnan Venkateswaran
  Published: Prentice Hall
  Date: April, 2008
  Pages: 744
  ISBN: 978-0132396554

- Title: **Linux Device Drivers, 3rd Edition**

  Authors: Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman
  Publisher: O'Reilly & Associates
  Date: 2005
  Pages: 636
  ISBN: 0-596-00590-3

Notes: Further information in http://www.oreilly.com/catalog/linuxdrive3/ PDF format, URL: http://lwn.net/Kernel/LDD3/

- Title: **Linux Kernel Internals**

Author: Michael Beck
Publisher: Addison-Wesley
Date: 1997
ISBN: 0-201-33143-8 (second edition)

- Title: **Programmation Linux 2.0 API systeme et fonctionnement du noyau**

Author: Remy Card, Eric Dumas, Franck Mevel
Publisher: Eyrolles
Date: 1997
Pages: 520
ISBN: 2-212-08932-5
Notes: French

- Title: **The Design and Implementation of the 4.4 BSD UNIX Operating System**

Author: Marshall Kirk McKusick, Keith Bostic, Michael J. Karels, John S. Quarterman
Publisher: Addison-Wesley
Date: 1996
ISBN: 0-201-54979-4

- Title: **Unix internals -- the new frontiers**

Author: Uresh Vahalia
Publisher: Prentice Hall
Date: 1996
Pages: 600
ISBN: 0-13-101908-2

- Title: **Programming for the real world - POSIX.4**

Author: Bill O. Gallmeister
Publisher: O'Reilly & Associates, Inc
Date: 1995
Pages: 552
ISBN: I-56592-074-0
Notes: Though not being directly about Linux, Linux aims to be POSIX. Good reference.

- Title: **UNIX Systems for Modern Architectures: Symmetric Multiprocessing and Caching for Kernel Programmers**

Author: Curt Schimmel
Publisher: Addison Wesley
Date: June, 1994
Pages: 432
ISBN: 0-201-63338-8

- Title: **The Design and Implementation of the 4.3 BSD UNIX Operating System**

Author: Samuel J. Leffler, Marshall Kirk McKusick, Michael J Karels, John S. Quarterman
Publisher: Addison-Wesley

Date: 1989 (reprinted with corrections on October, 1990)
ISBN: 0-201-06196-1

- Title: **The Design of the UNIX Operating System**

Author: Maurice J. Bach
Publisher: Prentice Hall
Date: 1986
Pages: 471
ISBN: 0-13-201757-1

Miscellaneous

- Name: **Cross-Referencing Linux**

URL: http://lxr.free-electrons.com/
Keywords: Browsing source code.
Description: Another web-based Linux kernel source code browser. Lots of cross references to variables and functions. You can see where they are defined and where they are used.

- Name: **Linux Weekly News**

URL: http://lwn.net
Keywords: latest kernel news.
Description: The title says it all. There's a fixed kernel section summarizing developers' work, bug fixes, new features and versions produced during the week. Published every Thursday.

- Name: **The home page of Linux-MM**

Author: The Linux-MM team.
URL: http://linux-mm.org/
Keywords: memory management, Linux-MM, mm patches, TODO, docs, mailing list.
Description: Site devoted to Linux Memory Management development. Memory related patches, HOWTOs, links, mm developers... Don't miss it if you are interested in memory management development!

- Name: **Kernel Newbies IRC Channel and Website**

URL: http://www.kernelnewbies.org
Keywords: IRC, newbies, channel, asking doubts.
Description: #kernelnewbies on irc.oftc.net. #kernelnewbies is an IRC network dedicated to the 'newbie' kernel hacker. The audience mostly consists of people who are learning about the kernel, working on kernel projects or professional kernel hackers that want to help less seasoned kernel people. #kernelnewbies is on the OFTC IRC Network. Try irc.oftc.net as your server and then /join #kernelnewbies. The kernelnewbies website also hosts articles, documents, FAQs...

- Name: **linux-kernel mailing list archives and search engines**

URL: http://vger.kernel.org/vger-lists.html
URL: http://www.uwsg.indiana.edu/hypermail/linux/kernel/index.html
URL: http://groups.google.com/group/mlist.linux.kernel
Keywords: linux-kernel, archives, search.

Description: Some of the linux-kernel mailing list archivers. If you have a better/another one, please let me know.

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This document is based on:

http://www.dit.upm.es/~jmseyas/linux/kernel/hackers-docs.html