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# FreeBSD Device Drivers: A Guide For The Intrepid

*Learn to develop customized device drivers for your embedded Linux system About This Book Learn to develop customized Linux device drivers Learn the core concepts of device drivers such as memory management, kernel caching, advanced IRQ management, and so on.*

*Practical experience on the embedded side of Linux Who This Book Is For This book will help anyone who wants to get started with developing their own Linux*

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*device drivers for embedded systems. Embedded Linux users will benefit highly from this book. This book covers all about device driver development, from char drivers to network device drivers to memory management. What You Will Learn Use kernel facilities to develop powerful drivers Develop drivers for widely used I2C and SPI devices and use the regmap API Write and support devicetree from within your drivers Program advanced drivers for network and frame buffer devices Delve into the Linux irqdomain API and write interrupt controller drivers Enhance your skills with*

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*regulator and PWM frameworks  
Develop measurement system  
drivers with IIO framework  
Get the best from memory  
management and the DMA  
subsystem Access and manage  
GPIO subsystems and develop  
GPIO controller drivers In  
Detail Linux kernel is a  
complex, portable, modular  
and widely used piece of  
software, running on around  
80% of servers and embedded  
systems in more than half of  
devices throughout the  
World. Device drivers play a  
critical role in how well a  
Linux system performs. As  
Linux has turned out to be  
one of the most popular  
operating systems used, the  
interest in developing*

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proprietary device drivers is also increasing steadily. This book will initially help you understand the basics of drivers as well as prepare for the long journey through the Linux Kernel. This book then covers drivers development based on various Linux subsystems such as memory management, PWM, RTC, IIO, IRQ management, and so on. The book also offers a practical approach on direct memory access and network device drivers. By the end of this book, you will be comfortable with the concept of device driver development and will be in a position to write any device driver from

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scratch using the latest kernel version (v4.13 at the time of writing this book).  
Style and approach A set of engaging examples to develop Linux device drivers  
FreeBSD—the powerful, flexible, and free Unix-like operating system—is the preferred server for many enterprises. But it can be even trickier to use than either Unix or Linux, and harder still to master.  
Absolute FreeBSD, 2nd Edition is your complete guide to FreeBSD, written by FreeBSD committer Michael W. Lucas. Lucas considers this completely revised and rewritten second edition of his landmark work to be his

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*best work ever; a true product of his love for FreeBSD and the support of the FreeBSD community. Absolute FreeBSD, 2nd Edition covers installation, networking, security, network services, system performance, kernel tweaking, filesystems, SMP, upgrading, crash debugging, and much more, including coverage of how to:-Use advanced security features like packet filtering, virtual machines, and host-based intrusion detection -Build custom live FreeBSD CDs and bootable flash -Manage network services and filesystems -Use DNS and set up email, IMAP, web, and FTP*

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*services for both servers and clients -Monitor your system with performance-testing and troubleshooting tools -Run diskless systems -Manage schedulers, remap shared libraries, and optimize your system for your hardware and your workload -Build custom network appliances with embedded FreeBSD -Implement redundant disks, even without special hardware -Integrate FreeBSD-specific SNMP into your network management system. Whether you're just getting started with FreeBSD or you've been using it for years, you'll find this book to be the definitive guide to FreeBSD*

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that you've been waiting for.

*"Steve Rago offers valuable insights into the kernel-level features of SVR4 not covered elsewhere; I think readers will especially appreciate the coverage of STREAMS, TLI, and SLIP." - W. Richard Stevens, author of UNIX Network Programming, Advanced Programming in the UNIX Environment, TCP/IP Illustrated Volume 1, and TCP/IP Illustrated Volume 2 Finally, with UNIX(R) System V Network Programming, an authoritative reference is available for programmers and system architects interested in building networked and distributed*



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*applications for UNIX System V. Even if you currently use a different version of the UNIX system, such as the latest release of 4.3BSD or SunOS, this book is valuable to you because it is centered around UNIX System V Release 4, the version of the UNIX system that unified many of the divergent UNIX implementations. For those professionals new to networking and UNIX system programming, two introductory chapters are provided. The author then presents the programming interfaces most important to building communication software in System V, including STREAMS, the*

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*Transport Layer Interface library, Sockets, and Remote Procedure Calls. So that your designs are not limited to user-level, the author also explains how to write kernel-level communication software, including STREAMS drivers, modules, and multiplexors. Many examples are provided, including an Ethernet driver and a transport-level multiplexing driver. In the final chapter, the author brings the material from previous chapters together, presenting the design of a SLIP communication package.*

0201563185B04062001

*OpenBSD, the elegant, highly secure Unix-like operating*

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*system, is widely used as the basis for critical DNS servers, routers, firewalls, and more. This long-awaited second edition of Absolute OpenBSD maintains author Michael Lucas's trademark straightforward and practical approach that readers have enjoyed for years. You'll learn the intricacies of the platform, the technical details behind certain design decisions, and best practices, with bits of humor sprinkled throughout. This edition has been completely updated for OpenBSD 5.3, including new coverage of OpenBSD's boot system, security features like W^X and ProPolice, and*

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This introduction to networking on Linux now covers firewalls, including the use of ipchains and Netfilter, masquerading, and accounting. Other new topics in this second edition include Novell (NCP/IPX) support and INN (news administration).

Linux Kernel Module Programming Guide is for people who want to write kernel modules. It takes a hands-on approach starting with writing a small "hello, world" program, and quickly moves from there. Far from a boring text on programming, Linux Kernel Module Programming Guide has a lively style that entertains while it



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**Is For If you are an engineer who wishes to understand and use Linux in embedded devices, this book is for you. It is also for Linux developers and system programmers who are familiar with embedded systems and want to learn and program the best in class devices. It is appropriate for students studying embedded techniques, for developers implementing embedded Linux devices, and engineers supporting existing Linux devices. What You Will Learn Evaluate the Board Support Packages offered by most manufacturers of a system on**

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**Embedded Linux runs many of the devices we use every day, from smart TVs to WiFi routers, test equipment to industrial controllers - all of them have Linux at their heart. Linux is a core technology in the implementation of the inter-connected world of the Internet of Things. The comprehensive guide shows you the technologies and techniques required to build Linux into embedded systems. You will begin by learning about the fundamental elements that underpin all embedded Linux projects: the**

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**toolchain, the bootloader, the kernel, and the root filesystem. You'll see how to create each of these elements from scratch, and how to automate the process using Buildroot and the Yocto Project. Moving on, you'll find out how to implement an effective storage strategy for flash memory chips, and how to install updates to the device remotely once it is deployed. You'll also get to know the key aspects of writing code for embedded Linux, such as how to access hardware from applications, the implications of writing multi-threaded code, and**

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**techniques to manage memory in an efficient way. The final chapters show you how to debug your code, both in applications and in the Linux kernel, and how to profile the system so that you can look out for performance bottlenecks. By the end of the book, you will have a complete overview of the steps required to create a successful embedded Linux system. Style and approach This book is an easy-to-follow and pragmatic guide with in-depth analysis of the implementation of embedded devices. It follows the life cycle of a project from**

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**inception through to completion, at each stage giving both the theory that underlies the topic and practical step-by-step walkthroughs of an example implementation.**

**An in-depth guide of the FreeBSD Operating System Architecture. This manual is available online for free at [freebsd.org](http://freebsd.org). This manual is printed in grayscale.**

**To thoroughly understand what makes Linux tick and why it's so efficient, you need to delve deep into the heart of the operating system--into the Linux kernel itself. The kernel**

**is Linux--in the case of the Linux operating system, it's the only bit of software to which the term "Linux" applies. The kernel handles all the requests or completed I/O operations and determines which programs will share its processing time, and in what order. Responsible for the sophisticated memory management of the whole system, the Linux kernel is the force behind the legendary Linux efficiency. The new edition of Understanding the Linux Kernel takes you on a guided tour through the most significant data structures,**

many algorithms, and programming tricks used in the kernel. Probing beyond the superficial features, the authors offer valuable insights to people who want to know how things really work inside their machine. Relevant segments of code are dissected and discussed line by line. The book covers more than just the functioning of the code, it explains the theoretical underpinnings for why Linux does things the way it does. The new edition of the book has been updated to cover version 2.4 of the kernel, which is quite different from

**version 2.2: the virtual memory system is entirely new, support for multiprocessor systems is improved, and whole new classes of hardware devices have been added. The authors explore each new feature in detail. Other topics in the book include: Memory management including file buffering, process swapping, and Direct memory Access (DMA) The Virtual Filesystem and the Second Extended Filesystem Process creation and scheduling Signals, interrupts, and the essential interfaces to device drivers Timing**

**Synchronization in the kernel  
Interprocess Communication  
(IPC) Program execution  
Understanding the Linux  
Kernel, Second Edition will  
acquaint you with all the inner  
workings of Linux, but is more  
than just an academic  
exercise. You'll learn what  
conditions bring out Linux's  
best performance, and you'll  
see how it meets the challenge  
of providing good system  
response during process  
scheduling, file access, and  
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If knowledge is power, then  
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making practical use of DTrace immediately, whether you're an administrator, developer, analyst, architect, or support professional. The authors fully explain the goals, techniques, and output associated with each script or command. Drawing on their extensive experience, they provide strategy suggestions, checklists, and functional diagrams, as well as a chapter of advanced tips and tricks. You'll learn how to Write effective scripts using DTrace's D language Use DTrace to thoroughly understand system performance Expose functional areas of the operating system, including I/O, filesystems, and

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protocols Use DTrace in the application and database development process Identify and fix security problems with DTrace Analyze the operating system kernel Integrate DTrace into source code Extend DTrace with other tools This book will help you make the most of DTrace to solve problems more quickly and efficiently, and build systems that work faster and more reliably.

Linux® is being adopted by an increasing number of embedded systems developers, who have been won over by its sophisticated scheduling and networking, its cost-free license, its open development model, and the

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support offered by rich and powerful programming tools. While there is a great deal of hype surrounding the use of Linux in embedded systems, there is not a lot of practical information. Building Embedded Linux Systems is the first in-depth, hard-core guide to putting together an embedded system based on the Linux kernel. This indispensable book features arcane and previously undocumented procedures for: Building your own GNU development toolchain Using an efficient embedded development framework Selecting, configuring, building, and installing a target-specific

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kernel Creating a complete target root filesystem Setting up, manipulating, and using solid-state storage devices Installing and configuring a bootloader for the target Cross-compiling a slew of utilities and packages Debugging your embedded system using a plethora of tools and techniques Details are provided for various target architectures and hardware configurations, including a thorough review of Linux's support for embedded hardware. All explanations rely on the use of open source and free software packages. By presenting how to build the operating system components from pristine sources

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and how to find more documentation or help, this book greatly simplifies the task of keeping complete control over one's embedded operating system, whether it be for technical or sound financial reasons. Author Karim Yaghmour, a well-known designer and speaker who is responsible for the Linux Trace Toolkit, starts by discussing the strengths and weaknesses of Linux as an embedded operating system. Licensing issues are included, followed by a discussion of the basics of building embedded Linux systems. The configuration, setup, and use of over forty different open source and free

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software packages commonly used in embedded Linux systems are also covered. uClibc, BusyBox, U-Boot, OpenSSH, tftpd, tftp, strace, and gdb are among the packages discussed.

The Linux Programming Interface (TLPI) is the definitive guide to the Linux and UNIX programming interface—the interface employed by nearly every application that runs on a Linux or UNIX system. In this authoritative work, Linux programming expert Michael Kerrisk provides detailed descriptions of the system calls and library functions that you need in order to master the craft



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- Perform interprocess communication using pipes, message queues, shared memory, and semaphores
- Write network

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applications with the sockets API. While The Linux Programming Interface covers a wealth of Linux-specific features, including epoll, inotify, and the /proc file system, its emphasis on UNIX standards (POSIX.1-2001/SUSv3 and POSIX.1-2008/SUSv4) makes it equally valuable to programmers working on other UNIX platforms. The Linux Programming Interface is the most comprehensive single-volume work on the Linux and UNIX programming interface, and a book that's destined to become a new classic.

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*"Very comprehensive and detailed, covering almost every single Linux device driver type."*

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*The Most Practical Guide to Writing Linux Device Drivers*

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*this book is for Linux programmers beginning to find their way with Linux kernel development. Linux kernel and driver developers looking to overcome frequent and common kernel development issues, as well as understand kernel internals, will benefit from this book. A basic understanding of Linux CLI and C programming is required.*

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*approach that assumes no prior kernel hacking experience.*

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**not a computer handbook, tutorial, or reference. It is a self-help book that will let readers know they are not alone.**

**Device drivers make it possible for your software to communicate with your hardware, and because every operating system has specific requirements, driver writing is nontrivial. When developing for FreeBSD, you've probably had to scour the Internet and dig through the kernel sources to figure out how to write the drivers you need. Thankfully, that stops now. In FreeBSD**

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**Device Drivers, Joseph Kong will teach you how to master everything from the basics of building and running loadable kernel modules to more complicated topics like thread synchronization. After a crash course in the different FreeBSD driver frameworks, extensive tutorial sections dissect real-world drivers like the parallel port printer driver. You'll learn: -All about Newbus, the infrastructure used by FreeBSD to manage the hardware devices on your system -How to work with ISA, PCI,**



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**servers, routers, firewalls, and more. With this book, you'll learn the intricacies of the platform, the technical details behind certain design decisions, and best practices. This edition has been updated for OpenBSD 5.3, including new coverage of OpenBSD's boot system, security features like W^X and ProPolice, and advanced networking techniques. You'll also learn how to: manage network traffic with VLANs, trunks, IPv6, and the PF packet filter; make software management quick and**

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as both a working reference and an in-depth study of a leading contemporary, portable, open source operating system. Technical and sales support professionals will discover both FreeBSD ' s capabilities and its limitations. Applications developers will learn how to effectively and efficiently interface with it; system administrators will learn how to maintain, tune, and configure it; and systems programmers will learn how to extend, enhance, and interface with it. Marshall Kirk McKusick writes, consults, and teaches classes on UNIX- and BSD-related subjects. While at the University of California, Berkeley, he

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implemented the 4.2BSD fast filesystem. He was research computer scientist at the Berkeley Computer Systems Research Group (CSRG), overseeing development and release of 4.3BSD and 4.4BSD. He is a FreeBSD Foundation board member and a long-time FreeBSD committer. Twice president of the Usenix Association, he is also a member of ACM, IEEE, and AAAS. George V. Neville-Neil hacks, writes, teaches, and consults on security, networking, and operating systems. A FreeBSD Foundation board member, he served on the FreeBSD Core Team for four years. Since 2004, he has written the “ Kode Vicious ”

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column for Queue and Communications of the ACM. He is vice chair of ACM 's Practitioner Board and a member of Usenix Association, ACM, IEEE, and AAAS. Robert N.M. Watson is a University Lecturer in systems, security, and architecture in the Security Research Group at the University of Cambridge Computer Laboratory. He supervises advanced research in computer architecture, compilers, program analysis, operating systems, networking, and security. A FreeBSD Foundation board member, he served on the Core Team for ten years and has been a committer for fifteen years. He is a member of Usenix

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