Linux Device Drivers: Where The Kernel Meets The Hardware

LINUX DRIVER DEVELOPMENT FOR EMBEDDED PROCESSORS - SECOND EDITION - The flexibility of Linux embedded, the availability of powerful, energy efficient processors designed for embedded computing and the low cost of new processors are encouraging many industrial companies to come up with new developments based on embedded processors.

Current engineers have in their hands powerful tools for developing applications previously unimagined, but they need to understand the countless features that Linux offers today. This book will teach you how to develop device drivers for Device Tree Linux embedded systems. You will learn how to write different types of Linux drivers, as well as the appropriate APIs (Application Program Interfaces) and methods to interface with kernel and user spaces. This is a book is meant to be

practical, but also provides an important theoretical base. More than twenty drivers are written and ported to three different processors. You can choose between NXP i.MX7D, Microchip SAMA5D2 and Broadcom BCM2837 processors to develop and test the drivers, whose implementation is described in detail in the practical lab sections of the book. Before you start reading, I encourage you to acquire any of these processor boards whenever you have access to some

GPIOs, and at least one SPI and I2C controllers. The hardware configurations of the different evaluation boards used to develop the drivers are explained in detail throughout this book; one of the boards used to implement the drivers is the famous Raspberry PI 3 Model B board. You will learn how to develop drivers, from the simplest ones that do not interact with any external hardware, to drivers that manage different kind of devices: accelerometers, DACs,

ADCs, RGB LEDs, Multi-Display LED controllers, I/O expanders, and Buttons. You will also develop DMA drivers, drivers that manage interrupts, and drivers that write/read on the internal registers of the processor to control external devices. To easy the development of some of these drivers, you will use different types of Frameworks: Miscellaneous framework, LED framework, UIO framework, Input framework and the IIO industrial one. This second edition has been

updated to the v4.9 LTS kernel. Recently, all the drivers have been ported to the new Microchip SAMA5D27-SOM1 (SAMA5D27 System On Module) using kernel 4.14 LTS and included in the GitHub repository of this book; these drivers have been tested in the ATSAMA5D27-SOM1-EK1 evaluation platform; the ATSAMA5D27-SOM1-EK1 practice lab settings are not described throughout the text of this book, but in a practice labs user guide that can be downloaded from the book

?s GitHub.
This book is written for students or professionals who quickly want to learn Linux Kernel programming and device driver development. Each chapter in this book is associated with code samples and code commentary so that the readers may quickly un.
An exhaustive technical manual outlines the Windows NT concepts related to drivers; shows how to develop the best drivers for particular applications; covers the I/O Subsystem and implementation of standard

kernel mode drivers; and more. Original. (Intermediate).
Master the art of developing customized device drivers for your embedded Linux systems Key FeaturesStay up to date with the Linux PCI, ASoC, and V4L2 subsystems and write device drivers for themGet to grips with the Linux kernel power management infrastructureAdopt a practical approach to customizing your Linux environment using best practicesBook Description Linux is one of the

fastest-growing operating systems around the world, and in the last few years, the Linux kernel has evolved significantly to support a wide variety of embedded devices with its improved subsystems and a range of new features. With this book, you'll find out how you can enhance your skills to write custom device drivers for your Linux operating system. Mastering Linux Device Driver Development provides complete coverage of kernel topics, including video and audio

frameworks, that usually go unaddressed. You'll work with some of the most complex and impactful Linux kernel frameworks, such as PCI, ALSA for SoC, and Video4Linux2, and discover expert tips and best practices along the way. In addition to this, you'll understand how to make the most of frameworks such as NVMEM and Watchdog. Once you've got to grips with Linux kernel helpers, you'll advance to working with special device types such as Multi-Function Devices (MFD) followed by video

and audio device drivers. By the end of this book, you'll be able to write feature-rich device drivers and integrate them with some of the most complex Linux kernel frameworks, including V4L2 and ALSA for SoC. What you will learnExplore and adopt Linux kernel helpers for locking, work deferral, and interrupt managementUnderstand the Regmap subsystem to manage memory accesses and work with the IRQ subsystemGet to grips with the PCI subsystem and write reliable drivers for PCI

devicesWrite full multimedia device drivers using ALSA SoC and the V4L2 frameworkBuild power-aware device drivers using the kernel power management frameworkFind out how to get the most out of miscellaneous kernel subsystems such as NVMEM and WatchdogWho this book is for This book is for embedded developers, Linux system engineers, and system programmers who want to explore Linux kernel frameworks and subsystems. C programming skills and a basic understanding of driver

development are necessary to get started with this book.

Explore Linux system programming interfaces, theory, and practice

Linux Device Drivers

A Guide with Exercises

Linux Driver Development with Raspberry Pi - Practical Labs

Easy Linux Device Driver, Second Edition

Understanding the Linux Kernel

Learn to develop customized device drivers for your embedded Linux systemAbout 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 LinuxWho This Book Is ForThis book will help anyone who wants to get started with developing their own Linux 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 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 driversIn DetailLinux 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 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 scratch using the latest kernel version (v4.13 at the time of writing this book).Style and approachA set of engaging examples to develop Linux device drivers

Writing Linux Device Drivers is designed to show experienced programmers how to develop

device drivers for Linux systems, and give them a basic understanding and familiarity with the Linux kernel. Upon mastering this material, you will be familiar with the different kinds of device drivers used under Linux, and know the appropriate API's through which devices (both hard and soft) interface with the kernel. The purpose is to get you into coding as quickly as possible. Thus we'll tell you early on how to dynamically allocate memory in the simplest way, so you can actually write code, and then later cover the subject more thoroughly. Each section has exercises, most of which involve

writing code, designed to help you gain familiarity with programming for the Linux kernel. Solutions are provided. We are not aiming for an expert audience, but instead for a competent and motivated one.

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

memory management in a wide variety of environments. If knowledge is power, then this book will help you make the most of your Linux system.
Discover how to write high-quality character driver code, interface with userspace, work with chip memory, and gain an in-depth understanding of working with hardware interrupts and kernel synchronization Key FeaturesDelve into hardware interrupt handling, threaded IRQs, tasklets, softirqs, and understand which to use whenExplore powerful techniques to perform user-kernel interfacing, peripheral I/O and use kernel

mechanismsWork with key kernel synchronization primitives to solve kernel concurrency issuesBook Description Linux Kernel Programming Part 2 - Char Device Drivers and Kernel Synchronization is an ideal companion guide to the Linux Kernel Programming book. This book provides a comprehensive introduction for those new to Linux device driver development and will have you up and running with writing misc class character device driver code (on the 5.4 LTS Linux kernel) in next to no time. You'll begin by learning how to write a simple and complete misc class character driver before

interfacing your driver with user-mode processes via procfs, sysfs, debugfs, netlink sockets, and ioctl. You'll then find out how to work with hardware I/O memory. The book covers working with hardware interrupts in depth and helps you understand interrupt request (IRQ) allocation, threaded IRQ handlers, tasklets, and softirqs. You'll also explore the practical usage of useful kernel mechanisms, setting up delays, timers, kernel threads, and workqueues. Finally, you'll discover how to deal with the complexity of kernel synchronization with locking technologies (mutexes, spinlocks,

and atomic/refcount operators), including more advanced topics such as cache effects, a primer on lock-free techniques, deadlock avoidance (with lockdep), and kernel lock debugging techniques. By the end of this Linux kernel book, you'll have learned the fundamentals of writing Linux character device driver code for real-world projects and products. What you will learnGet to grips with the basics of the modern Linux Device Model (LDM)Write a simple yet complete misc class character device driverPerform user-kernel interfacing using popular methodsUnderstand and handle hardware interrupts

confidentlyPerform I/O on peripheral hardware chip memoryExplore kernel APIs to work with delays, timers, kthreads, and workqueuesUnderstand kernel concurrency issuesWork with key kernel synchronization primitives and discover how to detect and avoid deadlockWho this book is for An understanding of the topics covered in the Linux Kernel Programming book is highly recommended to make the most of this book. This book is for Linux programmers beginning to find their way with device driver development. Linux device driver developers looking to overcome

frequent and common kernel/driver development issues, as well as perform common driver tasks such as user-kernel interfaces, performing peripheral I/O, handling hardware interrupts, and dealing with concurrency will benefit from this book. A basic understanding of Linux kernel internals (and common APIs), kernel module development, and C programming is required.

Linux Device Drivers Development

Understanding Linux Network Internals

A comprehensive guide to kernel internals, writing kernel modules, and kernel synchronization

The Linux Kernel Module Programming Guide
Linux device drivers
LF331 Developing Linux Device Drivers
Covering everything from Linux basics to system administration and programming, this book walks readers through acquiring, installing and configuring a Linux system. Assuming no Linux or UNIX experience, the text includes five detailed, practice-driven case studies and numerous worked examples. Benvenuti describes the relationship between the Internet's TCP/IP implementation and the Linux Kernel so that programmers and

advanced administrators can modify and fine-tune their network environment.
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 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 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 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 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
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 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, USB, and other buses –The best ways to control and communicate with the hardware devices from user space –How to use Direct Memory Access (DMA) for maximum system performance –The inner workings of the virtual null modem terminal

driver, the USB printer driver, the Intel PCI Gigabit Ethernet adapter driver, and other important drivers –How to use Common Access Method (CAM) to manage host bus adapters (HBAs) Concise descriptions and extensive annotations walk you through the many code examples. Don't waste time searching man pages or digging through the kernel sources to figure out how to make that arcane bit of hardware work with your system. FreeBSD Device Drivers gives you the framework that you need to write any driver you want, now.

The Linux A-Z

Linux Device Driver

Development Cookbook
Learn to Develop Linux Embedded Drivers with Kernel 4. 9 LTS
Linux Device Driver Development
Write custom device drivers to support computer peripherals in Linux operating systems
Writing Linux Device Drivers

A Guide to Kernel Exploitation: Attacking the Core discusses the theoretical techniques and approaches needed to develop reliable and effective kernel-level exploits, and applies them to different operating systems, namely, UNIX

derivatives, Mac OS X, and Windows. Concepts and tactics are presented categorically so that even when a specifically detailed vulnerability has been patched, the foundational information provided will help hackers in writing a newer, better attack; or help pen testers, auditors, and the like develop a more concrete design and defensive structure. The book is organized into four parts. Part I introduces the kernel and sets out the theoretical basis on which to build the rest of the book. Part II focuses on

different operating systems and describes exploits for them that target various bug classes. Part III on remote kernel exploitation analyzes the effects of the remote scenario and presents new techniques to target remote issues. It includes a step-by-step analysis of the development of a reliable, one-shot, remote exploit for a real vulnerabilitya bug affecting the SCTP subsystem found in the Linux kernel. Finally, Part IV wraps up the analysis on kernel exploitation and looks at what the future

may hold. Covers a range of operating system families — UNIX derivatives, Mac OS X, Windows Details common scenarios such as generic memory corruption (stack overflow, heap overflow, etc.) issues, logical bugs and race conditions Delivers the reader from user-land exploitation to the world of kernel-land (OS) exploits/attacks, with a particular focus on the steps that lead to the creation of successful techniques, in order to give to the reader something more than just a set of

tricks
"Probably the most wide ranging and complete Linux device driver book I've read." --Alan Cox, Linux Guru and Key Kernel Developer "Very comprehensive and detailed, covering almost every single Linux device driver type." --Theodore Ts'o, First Linux Kernel Developer in North America and Chief Platform Strategist of the Linux Foundation The Most Practical Guide to Writing Linux Device Drivers Linux now offers an exceptionally robust environment for

driver development: with today's kernels, what once required years of development time can be accomplished in days. In this practical, example-driven book, one of the world's most experienced Linux driver developers systematically demonstrates how to develop reliable Linux drivers for virtually any device. Essential Linux Device Drivers is for any programmer with a working knowledge of operating systems and C, including programmers who have never written drivers

before. Sreekrishnan Venkateswaran focuses on the essentials, bringing together all the concepts and techniques you need, while avoiding topics that only matter in highly specialized situations. Venkateswaran begins by reviewing the Linux 2.6 kernel capabilities that are most relevant to driver developers. He introduces simple device classes; then turns to serial buses such as I2C and SPI; external buses such as PCMCIA, PCI, and USB; video, audio, block, network, and wireless device drivers;

user-space drivers; and drivers for embedded Linux–one of today's fastest growing areas of Linux development. For each, Venkateswaran explains the technology, inspects relevant kernel source files, and walks through developing a complete example. • Addresses drivers discussed in no other book, including drivers for I2C, video, sound, PCMCIA, and different types of flash memory • Demystifies essential kernel services and facilities, including kernel threads and helper

interfaces • Teaches polling, asynchronous notification, and I/O control • Introduces the Inter-Integrated Circuit Protocol for embedded Linux drivers • Covers multimedia device drivers using the Linux-Video subsystem and Linux-Audio framework • Shows how Linux implements support for wireless technologies such as Bluetooth, Infrared, WiFi, and cellular networking • Describes the entire driver development lifecycle, through debugging and maintenance • Includes reference appendixes

covering Linux assembly, BIOS calls, and Seq files Master the new Windows Driver Model (WDM) common to Windows 98 and Windows 2000. You get theory, instruction and practice in driver development, installation and debugging. Addresses hardware and software interface issues, driver types, and a description of the new 'layer' model of WDM. ;
Over 30 recipes to develop custom drivers for your embedded Linux applications. Key Features Use Kernel facilities to

develop powerful drivers Via a practical approach, learn core concepts of developing device drivers Program a custom character device to get access to kernel internals Book Description Linux is a unified kernel that is widely used to develop embedded systems. As Linux has turned out to be one of the most popular operating systems used, the interest in developing proprietary device drivers has also increased. Device drivers play a critical role in how the system performs and ensures that the device

works in the manner intended. By offering several examples on the development of character devices and how to use other kernel internals, such as interrupts, kernel timers, and wait queue, as well as how to manage a device tree, you will be able to add proper management for custom peripherals to your embedded system. You will begin by installing the Linux kernel and then configuring it. Once you have installed the system, you will learn to use the different kernel features and the character drivers.

You will also cover interrupts in-depth and how you can manage them. Later, you will get into the kernel internals required for developing applications. Next, you will implement advanced character drivers and also become an expert in writing important Linux device drivers. By the end of the book, you will be able to easily write a custom character driver and kernel code as per your requirements. What you will learn Become familiar with the latest kernel releases (4.19+/5.x) running on the

ESPRESSObin devkit, an ARM 64-bit machine Download, configure, modify, and build kernel sources Add and remove a device driver or a module from the kernel Master kernel programming Understand how to implement character drivers to manage different kinds of computer peripherals Become well versed with kernel helper functions and objects that can be used to build kernel applications Acquire a knowledge of in-depth concepts to manage custom hardware with Linux from

both the kernel and user space Who this book is for This book will help anyone who wants to develop their own Linux device drivers for embedded systems. Having basic hand-on with Linux operating system and embedded concepts is necessary.
Talking Directly to the Kernel and C Library
Create fast and reliable embedded solutions with Linux 5.4 and the Yocto Project 3.1 (Dunfell)
Linux Device Drivers, 3E
Linux in a Nutshell
PRACTICAL LINUX PROGRAMMING:Device

Drivers, Embedded Systems, and the Internet Advanced Linux Programming

Get up and running with system programming concepts in Linux Key FeaturesAcquire insight on Linux system architecture and its programming interfacesGet to grips with core concepts such as process management, signalling and pthreadsPacked with industry best practices and dozens of code examplesBook Description The Linux OS and its embedded and server applications are critical components of today's software infrastructure in a

decentralized, networked universe. The industry's demand for proficient Linux developers is only rising with time. Hands-On System Programming with Linux gives you a solid theoretical base and practical industry-relevant descriptions, and covers the Linux system programming domain. It delves into the art and science of Linux application programming– system architecture, process memory and management, signaling, timers, pthreads, and file IO. This book goes beyond the use API X to do Y approach; it explains the concepts and theories required to understand

programming interfaces and design decisions, the tradeoffs made by experienced developers when using them, and the rationale behind them. Troubleshooting tips and techniques are included in the concluding chapter. By the end of this book, you will have gained essential conceptual design knowledge and hands-on experience working with Linux system programming interfaces. What you will learnExplore the theoretical underpinnings of Linux system architectureUnderstand why modern OSes use virtual memory and dynamic memory APIsGet to grips with

dynamic memory issues and effectively debug themLearn key concepts and powerful system APIs related to process managementEffectively perform file IO and use signaling and timersDeeply understand multithreading concepts, pthreads APIs, synchronization and schedulingWho this book is for Hands-On System Programming with Linux is for Linux system engineers, programmers, or anyone who wants to go beyond using an API set to understanding the theoretical underpinnings and concepts behind powerful Linux system programming APIs. To get the most out of

this book, you should be familiar with Linux at the user-level logging in, using shell via the command line interface, the ability to use tools such as find, grep, and sort. Working knowledge of the C programming language is required. No prior experience with Linux systems programming is assumed.

Master the techniques needed to build great, efficient embedded devices on Linux About This Book Discover how to build and configure reliable embedded Linux devices This book has been updated to include Linux 4.9 and Yocto Project 2.2

(Morty) This comprehensive guide covers the remote update of devices in the field and power management Who This Book 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 chip or embedded module Use Buildroot and the Yocto Project to create embedded Linux systems quickly and efficiently Update IoT devices in the field without compromising security Reduce the power budget of devices to make batteries last longer Interact with the hardware without having to write kernel device drivers Debug devices remotely using GDB, and see how to measure the performance of the systems using powerful tools such as perk, ftrace, and valgrind Find out how to configure Linux as a real-

time operating system In Detail 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 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 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 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.
Nwely updated to include new calls and techniques introduced in Versions 2.2 and 2.4 of the Linux kernel, a definitive resource for those who want to support computer peripherals under the Linux operating system explains how to write a driver for a broad spectrum of devices, including character devices, network interfaces, and block devices. Original. (Intermediate)
Linux Driver Development with Raspberry Pi - Practical Labs Embedded systems have become an

integral part of our daily life. They are deployed in mobile devices, networking infrastructure, home and consumer devices, digital signage, medical imaging, automotive infotainment and many other industrial applications. The use of embedded systems is growing exponentially. Many of these embedded systems are powered by an inexpensive yet powerful system-on-chip (SoC) that is running a Linux operating system. The BCM2837 from Broadcom is one of these SoCs, running quad ARM Cortex A53 cores at 1.2GHz. This is the SoC used in the popular Raspberry Pi 3 boards. This book follows

the learning by doing approach, so you will be playing with your Raspberry Pi since the first chapter. Besides the Raspberry Pi board, you will use several low-cost boards to develop the hands-on examples. In the labs, it is described what each step means in detail so that you can use your own hardware components adapting the content of the book to your needs. You will learn how to develop Linux drivers for the Raspberry Pi boards. You will start with the simplest ones that do not interact with any external hardware, then you will develop Linux drivers that manage different kind

of devices: Accelerometer, DAC, ADC, RGB LED, Buttons, Joystick controller, Multi-Display LED controller and I/O expanders controlled via I2C and SPI buses. You will also develop DMA drivers, USB device drivers, drivers that manage interrupts and drivers that write and read on the internal registers of the SoC to control its GPIOs. To ease the development of some of these drivers, you will use different types of Linux kernel subsystems: Miscellaneous, LED, UIO, USB, Input and Industrial I/O. More than 30 kernel modules have been written (besides several user

applications), which can be downloaded from the book's GitHub repository. This book uses the Long Term Support (LTS) Linux kernel 5.4, which was released on November 2019 and will be maintained until December 2025. The Linux drivers and applications developed in the labs have been ported to three different Raspberry Pi boards: Raspberry Pi 3 Model B, Raspberry Pi 3 Model B+ and Raspberry Pi 4 Model B. This book is a learning tool to start developing drivers without any previous knowledge about this field, so the intention during its writing has been to develop drivers without a high level

of complexity that both serve to reinforce the main driver development concepts and can be a starting point to help you to develop your own drivers. And, remember that the best way to develop a driver is not to write it from scratch. You can reuse free code from similar Linux kernel mainline drivers. All the drivers written throughout this book are GPL licensed, so you can modify and redistribute them under the same license.

First Step Towards Device Driver Programming

Mastering Embedded Linux Programming

Develop custom drivers for your embedded Linux

applications
Embedded Linux Primer
Attacking the Core
Mastering Linux Device Driver Development
Presents an overview of kernel configuration and building for version 2.6 of the Linux kernel.
Embedded Linux Development is designed to give experienced programmers a solid understanding of adapting the Linux kernel and customized user-space libraries and utilities to embedded applications such as those in use in consumer electronics, military, medical, industrial, and auto industries. This five day course includes extensive hands-on exercises and demonstrations

designed to give you the necessary tools to develop an embedded Linux device.

This is the eBook version of the printed book. If the print book includes a CD-ROM, this content is not included within the eBook version. Advanced Linux Programming is divided into two parts. The first covers generic UNIX system services, but with a particular eye towards Linux specific information. This portion of the book will be of use even to advanced programmers who have worked with other Linux systems since it will cover Linux specific details and differences. For programmers without UNIX experience, it will be even more

valuable. The second section covers material that is entirely Linux specific. These are truly advanced topics, and are the techniques that the gurus use to build great applications. While this book will focus mostly on the Application Programming Interface (API) provided by the Linux kernel and the C library, a preliminary introduction to the development tools available will allow all who purchase the book to make immediate use of Linux.
Windows Embedded Compact 7 is the natural choice for developing sophisticated, small-footprint devices for both consumers and the enterprise. For this latest version, a number of significant

enhancements have been made, most notably the ability to run multi-core processors and address more than the 512 MB of memory constraint in previous versions. Using familiar developer tools, Pro Windows Embedded Compact 7 will take you on a deep-dive into device driver development. You'll learn how to set up your working environment, the tools that you'll need and how to think about developing for small devices before quickly putting theory into practice and developing your own first driver from the ground up. As you delve deeper into the details of driver development, you'll learn how to master hardware details, deal with I/O and interrupts, work with

networks, and test and debug your drivers ready for deployment—all in the company of an author who's been working with Windows CE for more than a decade. Packed with code samples, Pro Windows Embedded Compact 7 contains everything you'll need to start developing for small footprint devices with confidence.

Linux Kernel Development

Create user-kernel interfaces, work with peripheral I/O, and handle hardware interrupts

A Guide for the Intrepid

Producing Device Drivers

Writing Windows WDM Device Drivers

A Guide to Kernel Exploitation

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 educates. An excellent guide for anyone wishing to get started on kernel module programming. *** Money raised from the sale of this book supports the development of free software and documentation.

Easy Linux Device Driver : First Step Towards Device Driver Programming Easy Linux Device Driver book is an easy and friendly way of learning device

driver programming . Book contains all latest programs along with output screen screenshots. Highlighting important sections and stepwise approach helps for quick understanding of programming . Book contains Linux installation ,Hello world program up to USB 3.0 ,Display Driver ,PCI device driver programming concepts in stepwise approach. Program gives best understanding of theoretical and practical fundamentals of Linux device driver. Beginners should start learning Linux device driver from this book to become device driver expertise. Topics covered: Introduction of Linux Advantages of Linux History of Linux Architecture of Linux Definations

Ubuntu installation Ubuntu Installation Steps User Interface Difference About KNOPPIX Important links Terminal: Soul of Linux Creating Root account Terminal Commands Virtual Editor Commands Linux Kernel Linux Kernel Internals Kernel Space and User space Device Driver Place of Driver in System Device Driver working Characteristics of Device Driver Module Commands Hello World Program pre-settings Write Program Printk function Makefile Run program Parameter passing Parameter passing program Parameter Array Process related program Process related program Character Device Driver Major and Minor number API to registers a device Program to

show device number Character Driver File Operations File operation program. Include .h header Functions in module.h file Important code snippets Summary of file operations PCI Device Driver Direct Memory Access Module Device Table Code for Basic Device Driver Important code snippets USB Device Driver Fundamentals Architecture of USB device driver USB Device Driver program Structure of USB Device Driver Parts of USB end points Importent features USB information Driver USB device Driver File Operations Using URB Simple data transfer Program to read and write Important code snippets Gadget Driver Complete USB Device

Driver Program Skeleton Driver Program Special USB 3.0 USB 3.0 Port connection Bulk endpoint streaming Stream ID Device Driver Lock Mutual Exclusion Semaphore Spin Lock Display Device Driver Frame buffer concept Framebuffer Data Structure Check and set Parameter Accelerated Method Display Driver summary Memory Allocation Kmalloc Vmalloc Ioremap Interrupt Handling interrupt registration Proc interface Path of interrupt Programming Tips Softirqs, Tasklets, Work Queues I/O Control Introducing ioctl Prototype Stepwise execution of ioctl Sample Device Driver Complete memory Driver Complete Parallel Port Driver

Device Driver Debugging Data Display Debugger Graphical Display Debugger Kernel Graphical Debugger Appendix I Exported Symbols Kobjects, Ksets, and Subsystems DMA I/O Device drivers literally drive everything you're interested in--disks, monitors, keyboards, modems--everything outside the computer chip and memory. And writing device drivers is one of the few areas of programming for the Linux operating system that calls for unique, Linux-specific knowledge. For years now, programmers have relied on the classic Linux Device Drivers from O'Reilly to master this critical subject. Now in its third edition, this bestselling guide provides all the information you'll need to

write drivers for a wide range of devices.Over the years the book has helped countless programmers learn: how to support computer peripherals under the Linux operating system how to develop and write software for new hardware under Linux the basics of Linux operation even if they are not expecting to write a driver The new edition of Linux Device Drivers is better than ever. The book covers all the significant changes to Version 2.6 of the Linux kernel, which simplifies many activities, and contains subtle new features that can make a driver both more efficient and more flexible. Readers will find new chapters on important types of drivers not covered

previously, such as consoles, USB drivers, and more.Best of all, you don't have to be a kernel hacker to understand and enjoy this book. All you need is an understanding of the C programming language and some background in Unix system calls. And for maximum ease-of-use, the book uses full-featured examples that you can compile and run without special hardware.Today Linux holds fast as the most rapidly growing segment of the computer market and continues to win over enthusiastic adherents in many application areas. With this increasing support, Linux is now absolutely mainstream, and viewed as a solid platform for embedded systems. If you're

writing device drivers, you'll want this book. In fact, you'll wonder how drivers are ever written without it.

Contains an introduction to the operating system with detailed documentation on commands, utilities, programs, system configuration, and networking.

Essential Linux Device Drivers

Linux Kernel Programming

Linux Driver Development for Embedded Processors - Second Edition

Linux Kernel in a Nutshell

FreeBSD Device Drivers

A Simpler Approach to Linux Kernel

Harness the power of Linux to create versatile and robust embedded solutions

Key FeaturesLearn how to develop and configure robust embedded Linux devicesExplore the new features of Linux 5.4 and the Yocto Project 3.1 (Dunfell)Discover different ways to debug and profile your code in both user space and the Linux kernelBook Description If you're looking for a book that will demystify embedded Linux, then you've come to the right place. Mastering Embedded Linux Programming is a fully comprehensive guide that can serve both as means to learn new

things or as a handy reference. The first few chapters of this book will break down the fundamental elements that underpin all embedded Linux projects: the toolchain, the bootloader, the kernel, and the root filesystem. After that, you will learn how to create each of these elements from scratch and automate the process using Buildroot and the Yocto Project. As you progress, the book will show you how to implement an effective storage strategy for flash memory chips and install

updates to a device remotely once it's deployed. You'll also learn about the key aspects of writing code for embedded Linux, such as how to access hardware from apps, the implications of writing multi-threaded code, and techniques to manage memory in an efficient way. The final chapters demonstrate how to debug your code, whether it resides in apps or in the Linux kernel itself. You'll also cover the different tracers and profilers that are

available for Linux so that you can quickly pinpoint any performance bottlenecks in your system. By the end of this Linux book, you'll be able to create efficient and secure embedded devices using Linux. What you will learnUse Buildroot and the Yocto Project to create embedded Linux systemsTroubleshoot BitBake build failures and streamline your Yocto development workflowUpdate IoT devices securely in the field using Mender or balenaPrototype peripheral additions by reading

schematics, modifying device trees, soldering breakout boards, and probing pins with a logic analyzerInteract with hardware without having to write kernel device driversDivide your system up into services supervised by BusyBox runitDebug devices remotely using GDB and measure the performance of systems using tools such as perf, ftrace, eBPF, and CallgrindWho this book is for If you're a systems software engineer or system administrator who wants to learn how to

implement Linux on embedded devices, then this book is for you. It's also aimed at embedded systems engineers accustomed to programming for low-power microcontrollers, who can use this book to help make the leap to high-speed systems on chips that can run Linux. Anyone who develops hardware that needs to run Linux will find something useful in this book – but before you get started, you'll need a solid grasp on POSIX standard, C programming, and shell scripting.

Provides information on writing a driver in Linux, covering such topics as character devices, network interfaces, driver debugging, concurrency, and interrupts.
Up-to-the-Minute, Complete Guidance for Developing Embedded Solutions with Linux Linux has emerged as today's #1 operating system for embedded products. Christopher Hallinan's Embedded Linux Primer has proven itself as the definitive real-world guide to building efficient, high-value, embedded systems with

Linux. Now, Hallinan has thoroughly updated this highly praised book for the newest Linux kernels, capabilities, tools, and hardware support, including advanced multicore processors. Drawing on more than a decade of embedded Linux experience, Hallinan helps you rapidly climb the learning curve, whether you're moving from legacy environments or you're new to embedded programming. Hallinan addresses today's most important development challenges and demonstrates how to solve

the problems you're most likely to encounter. You'll learn how to build a modern, efficient embedded Linux development environment, and then utilize it as productively as possible. Hallinan offers up-to-date guidance on everything from kernel configuration and initialization to bootloaders, device drivers to file systems, and BusyBox utilities to real-time configuration and system analysis. This edition adds entirely new chapters on UDEV, USB, and open source build systems.

Tour the typical embedded system and development environment and understand its concepts and components. Understand the Linux kernel and userspace initialization processes. Preview bootloaders, with specific emphasis on U-Boot. Configure the Memory Technology Devices (MTD) subsystem to interface with flash (and other) memory devices. Make the most of BusyBox and latest open source development tools. Learn from expanded and updated coverage of kernel debugging. Build and analyze real-time

systems with Linux. Learn to configure device files and driver loading with UDEV. Walk through detailed coverage of the USB subsystem. Introduces the latest open source embedded Linux build systems. Reference appendices include U-Boot and BusyBox commands. UNIX, UNIX LINUX & UNIX TCL/TK. Write software that makes the most effective use of the Linux system, including the kernel and core system libraries. The majority of both Unix and Linux code is still written at the

system level, and this book helps you focus on everything above the kernel, where applications such as Apache, bash, cp, vim, Emacs, gcc, gdb, glibc, ls, mv, and X exist. Written primarily for engineers looking to program at the low level, this updated edition of Linux System Programming gives you an understanding of core internals that makes for better code, no matter where it appears in the stack. -- Provided by publisher.

Where the Kernel Meets the Hardware

Linux Kernel and Device Driver Programming
A Practical Real-World Approach
Pro Windows Embedded Compact 7
Linux Kernel Programming Part 2 - Char Device Drivers and Kernel Synchronization
Linux System Programming

Device drivers literally drive everything you're interested in--disks, monitors, keyboards, modems--everything outside the computer chip and memory. And writing device drivers is one of the few areas of programming for the Linux operating system that

calls for unique, Linux-specific knowledge. For years now, programmers have relied on the classic Linux Device Drivers from O'Reilly to master this critical subject. Now in its third edition, this bestselling guide provides all the information you'll need to write drivers for a wide range of devices.
Learn how to write high-quality kernel module code, solve common Linux kernel programming issues, and understand the fundamentals of Linux kernel internals Key FeaturesDiscover how to write kernel code using the Loadable Kernel Module frameworkExplore industry-

grade techniques to perform efficient memory allocation and data synchronization within the kernelUnderstand the essentials of key internals topics such as kernel architecture, memory management, CPU scheduling, and kernel synchronizationBook Description Linux Kernel Programming is a comprehensive introduction for those new to Linux kernel and module development. This easy-to-follow guide will have you up and running with writing kernel code in next-to-no time. This book uses the latest 5.4 Long-Term Support (LTS) Linux kernel, which

will be maintained from November 2019 through to December 2025. By working with the 5.4 LTS kernel throughout the book, you can be confident that your knowledge will continue to be valid for years to come. You'll start the journey by learning how to build the kernel from the source. Next, you'll write your first kernel module using the powerful Loadable Kernel Module (LKM) framework. The following chapters will cover key kernel internals topics including Linux kernel architecture, memory management, and CPU scheduling. During the course of this book, you'll

delve into the fairly complex topic of concurrency within the kernel, understand the issues it can cause, and learn how they can be addressed with various locking technologies (mutexes, spinlocks, atomic, and refcount operators). You'll also benefit from more advanced material on cache effects, a primer on lock-free techniques within the kernel, deadlock avoidance (with lockdep), and kernel lock debugging techniques. By the end of this kernel book, you'll have a detailed understanding of the fundamentals of writing Linux kernel module code for

real-world projects and products. What you will learnWrite high-quality modular kernel code (LKM framework) for 5.x kernelsConfigure and build a kernel from sourceExplore the Linux kernel architectureGet to grips with key internals regarding memory management within the kernelUnderstand and work with various dynamic kernel memory alloc/dealloc APIsDiscover key internals aspects regarding CPU scheduling within the kernelGain an understanding of kernel concurrency issuesFind out how to work with key kernel synchronization

primitivesWho this book is for This book is for Linux programmers beginning to find their way with Linux kernel development. If you're a Linux kernel and driver developer looking to overcome frequent and common kernel development issues, or understand kernel intervals, you'll find plenty of useful information. You'll need a solid foundation of Linux CLI and C programming before you can jump in.
Provides a definitive resource for those who want to support computer peripherals under the Linux operating system, explaining how to write a driver for a

broad spectrum of devices, including character devices, network interfaces, and block devices. Original. (Intermediate).
Get up to speed with the most important concepts in driver development and focus on common embedded system requirements such as memory management, interrupt management, and locking mechanisms Key FeaturesWrite feature-rich and customized Linux device drivers for any character, SPI, and I2C deviceDevelop a deep understanding of locking primitives, IRQ management, memory management, DMA, and so onGain practical experience in the embedded

side of Linux using GPIO, IIO, and input subsystemsBook Description Linux is by far the most-used kernel on embedded systems. Thanks to its subsystems, the Linux kernel supports almost all of the application fields in the industrial world. This updated second edition of Linux Device Driver Development is a comprehensive introduction to the Linux kernel world and the different subsystems that it is made of, and will be useful for embedded developers from any discipline. You'll learn how to configure, tailor, and build the Linux kernel.

Filled with real-world examples, the book covers each of the most-used subsystems in the embedded domains such as GPIO, direct memory access, interrupt management, and I2C/SPI device drivers. This book will show you how Linux abstracts each device from a hardware point of view and how a device is bound to its driver(s). You'll also see how interrupts are propagated in the system as the book covers the interrupt processing mechanisms in-depth and describes every kernel structure and API involved. This new edition also addresses how not to write

device drivers using user space libraries for GPIO clients, I2C, and SPI drivers. By the end of this Linux book, you'll be able to write device drivers for most of the embedded devices out there. What you will learnDownload, configure, build, and tailor the Linux kernelDescribe the hardware using a device treeWrite feature-rich platform drivers and leverage I2C and SPI busesGet the most out of the new concurrency managed workqueue infrastructureUnderstand the Linux kernel timekeeping mechanism and use time-related APIsUse the regmap framework to factor the code

and make it genericOffload CPU for memory copies using DMAInteract with the real world using GPIO, IIO, and input subsystemsWho this book is for This Linux OS book is for embedded system and embedded Linux enthusiasts/developers who want to get started with Linux kernel development and leverage its subsystems. Electronic hackers and hobbyists interested in Linux kernel development as well as anyone looking to interact with the platform using GPIO, IIO, and input subsystems will also find this book useful.

Windows NT Device Driver Development

Everything you need to start with device driver development for Linux kernel and embedded Linux
Develop customized drivers for embedded Linux
Hands-On System Programming with Linux
Includes Index