

Practical Linux Programming Device Drivers Embedded Systems And The Internet Programming Series

In-depth instruction and practical techniques for building with the BeagleBone embedded Linux platform Exploring BeagleBone is a hands-on guide to bringing gadgets, gizmos, and robots to life using the popular BeagleBone embedded Linux platform. Comprehensive content and deep detail provide more than just a BeagleBone instruction manual—you'll also learn the underlying engineering techniques that will allow you to create your own projects. The book begins with a foundational primer on essential skills, and then gradually moves into communication, control, and advanced applications using C/C++, allowing you to learn at your own pace. In addition, the book's companion website features instructional videos, source code, discussion forums, and more, to ensure that you have everything you need. The BeagleBone's small size, high performance, low cost, and extreme adaptability have made it a favorite development platform, and the Linux software base allows for complex yet flexible functionality. The BeagleBone has applications in smart buildings, robot control, environmental sensing, to name a few; and, expansion boards and peripherals dramatically increase the possibilities. Exploring BeagleBone provides a reader-friendly guide to the device, including a crash course in computer engineering. While following step by step, you can: Get up to speed on embedded Linux, electronics, and programming Master interfacing electronic circuits, buses and modules, with practical examples Explore the Internet-connected BeagleBone and the BeagleBone with a display Apply the BeagleBone to sensing applications, including video and sound Explore the BeagleBone's Programmable Real-Time Controllers Hands-on learning helps ensure that your new skills stay with you, allowing you to design with electronics, modules, or peripherals even beyond the BeagleBone. Insightful guidance and online peer support help you transition from beginner to expert as you master the techniques presented in Exploring BeagleBone, the practical handbook for the popular computing platform. 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

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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.

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

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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 ATSAM5D27-SOM1-EK1 evaluation platform; the ATSAM5D27-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.

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.

Twenty five years ago, as often happens in our industry, pundits laughed at and called Linux a joke. To say that view has changed is a massive understatement. This book will cement for you both the conceptual 'why' and the practical 'how' of systems programming on Linux, and covers Linux systems programming on the latest 4.x kernels.

Newly 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)

Docker is rapidly changing the way organizations deploy software at scale. However, understanding how Linux containers fit into your workflow—and getting the integration details right—is not a trivial task. With the updated edition of this practical guide, you'll learn how to use Docker to package your applications with all of their dependencies and then test, ship, scale, and support your containers in production. This edition includes significant updates to the examples and explanations that reflect the substantial changes that have occurred over the past couple of years. Sean Kane and Karl Matthias have added a complete chapter on Docker Compose, deeper coverage of Docker Swarm mode, introductions to both Kubernetes and AWS Fargate, examples on how to optimize your Docker images, and much more. Learn how Docker simplifies dependency management and deployment workflow for your applications Start working with Docker images, containers, and command line tools Use practical techniques to deploy and test Docker containers in production Debug containers by understanding their

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composition and internal processes Deploy production containers at scale inside your data center or cloud environment Explore advanced Docker topics, including deployment tools, networking, orchestration, security, and configuration

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.

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

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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.

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

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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 Important 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

Find an introduction to the architecture, concepts and algorithms of the Linux
kernel in Professional Linux Kernel Architecture, a guide to the kernel sources
and large number of connections among subsystems. Find an introduction to the
relevant structures and functions exported by the kernel to userland, understand
the theoretical and conceptual aspects of the Linux kernel and Unix derivatives,
and gain a deeper understanding of the kernel. Learn how to reduce the vast
amount of information contained in the kernel sources and obtain the skills
necessary to understand the kernel sources.

Learn how to write high-quality kernel module code, solve common Linux kernel
programming issues, and understand the fundamentals of Linux kernel internals
Key Features Discover how to write kernel code using the Loadable Kernel
Module framework Explore industry-grade techniques to perform efficient
memory allocation and data synchronization within the kernel Understand the
essentials of key internals topics such as kernel architecture, memory
management, CPU scheduling, and kernel synchronization Book 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

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be valid for years to come. This Linux book begins by showing you how to build the kernel from the source. Next, you'll learn how to write your first kernel module using the powerful Loadable Kernel Module (LKM) framework. The book then covers key kernel internals topics including Linux kernel architecture, memory management, and CPU scheduling. Next, 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 learn Write high-quality modular kernel code (LKM framework) for 5.x kernels Configure and build a kernel from source Explore the Linux kernel architecture Get to grips with key internals regarding memory management within the kernel Understand and work with various dynamic kernel memory alloc/dealloc APIs Discover key internals aspects regarding CPU scheduling within the kernel Gain an understanding of kernel concurrency issues Find out how to work with key kernel synchronization primitives Who this book is for 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.

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 `perf`, `ftrace`, and `valgrind`* Find out how to configure Linux as a real-time operating system In Detail Embedded Linux runs

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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.

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).

Describes the concepts of programming with Linux, covering such topics as shell programming, file structure, managing memory, using MySQL, debugging, processes and signals, and GNOME.

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 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 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

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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 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 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.

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. Master the techniques needed to build great, efficient embedded devices on Linux About This Book Discover how to build and configure reliable embedded

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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 `perf`, `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.

Based upon the authors' experience in designing and deploying an embedded Linux system with a variety of applications, *Embedded Linux System Design and Development* contains a full embedded Linux system development roadmap for systems architects and software programmers. Explaining the issues that arise

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out of the use of Linux in embedded systems, the book facilitates movement to embedded Linux from traditional real-time operating systems, and describes the system design model containing embedded Linux. This book delivers practical solutions for writing, debugging, and profiling applications and drivers in embedded Linux, and for understanding Linux BSP architecture. It enables you to understand: various drivers such as serial, I2C and USB gadgets; uClinux architecture and its programming model; and the embedded Linux graphics subsystem. The text also promotes learning of methods to reduce system boot time, optimize memory and storage, and find memory leaks and corruption in applications. This volume benefits IT managers in planning to choose an embedded Linux distribution and in creating a roadmap for OS transition. It also describes the application of the Linux licensing model in commercial products. This book is broken into four primary sections addressing key topics that Linux programmers need to master: Linux nuts and bolts, the Linux kernel, the Linux desktop, and Linux for the Web Effective examples help get readers up to speed with building software on a Linux-based system while using the tools and utilities that contribute to streamlining the software development process Discusses using emulation and virtualization technologies for kernel development and application testing Includes useful insights aimed at helping readers understand how their applications code fits in with the rest of the software stack Examines cross-compilation, dynamic device insertion and removal, key Linux projects (such as Project Utopia), and the internationalization capabilities present in the GNOME desktop

Embedded Android is for Developers wanting to create embedded systems based on Android and for those wanting to port Android to new hardware, or creating a custom development environment. Hackers and moders will also find this an indispensable guide to how Android works.

Pajari provides application programmers with definitive information on writing device drivers for the UNIX operating system. The comprehensive coverage includes the four major categories of UNIX device drivers: character, block, terminal, and stream drivers. (Operating Systems)

Provides information on writing a driver in Linux, covering such topics as character devices, network interfaces, driver debugging, concurrency, and interrupts.

Mac OS X was released in March 2001, but many components, such as Mach and BSD, are considerably older. Understanding the design, implementation, and workings of Mac OS X requires examination of several technologies that differ in their age, origins, philosophies, and roles. Mac OS X Internals: A Systems Approach is the first book that dissects the internals of the system, presenting a detailed picture that grows incrementally as you read. For example, you will learn the roles of the firmware, the bootloader, the Mach and BSD kernel components (including the process, virtual memory, IPC, and file system layers), the object-oriented I/O Kit driver framework, user libraries, and other core pieces of

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software. You will learn how these pieces connect and work internally, where they originated, and how they evolved. The book also covers several key areas of the Intel-based Macintosh computers. A solid understanding of system internals is immensely useful in design, development, and debugging for programmers of various skill levels. System programmers can use the book as a reference and to construct a better picture of how the core system works. Application programmers can gain a deeper understanding of how their applications interact with the system. System administrators and power users can use the book to harness the power of the rich environment offered by Mac OS X. Finally, members of the Windows, Linux, BSD, and other Unix communities will find the book valuable in comparing and contrasting Mac OS X with their respective systems. Mac OS X Internals focuses on the technical aspects of OS X and is so full of extremely useful information and programming examples that it will definitely become a mandatory tool for every Mac OS X programmer.

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
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

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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 This book follows on from Linux Kernel Programming, helping you explore the Linux character device driver framework and enables you to write 'misc' class drivers. You'll learn how to efficiently interface with user apps, perform I/O on hardware memory, handle hardware interrupts, and leverage kernel delays, timers, kthreads, and workqueues.

This book contains the practical labs corresponding to the "Linux Kernel and Driver Development: Training Handouts" book from Bootlin. Get your hands on an embedded board based on an ARM processor (the Beagle Bone Black board), and apply what you learned: write a Device Tree to declare devices connected to your board, configure pin multiplexing, and implement drivers for I2C and serial devices. You will learn how to manage multiple devices with the same driver, to access and write hardware registers, to allocate memory, to register and manage interrupts, as well as how to debug your code and interpret the kernel error messages. You will also keep an eye on the board and CPU datasheets so that you will always understand the values that you feed to the kernel.

Find solutions to all your problems related to Linux system programming using practical recipes for developing your own system programs

Key Features

- Develop a deeper understanding of how Linux system programming works
- Gain hands-on experience of working with different Linux projects with the help of practical examples
- Learn how to develop your own programs for Linux

Book Description Linux is the world's most popular open source operating system (OS). Linux System Programming Techniques will enable you to extend the Linux OS with your own system programs and communicate with other programs on the system. The book begins by exploring the Linux filesystem, its basic commands, built-in manual pages, the GNU compiler collection (GCC), and Linux system calls. You'll then discover how to handle errors in your programs and will learn to catch errors and print relevant information about them. The book takes you through multiple recipes on how to read and write files on the system, using both streams and file descriptors. As you advance, you'll delve into forking, creating zombie processes, and daemons, along with recipes on how to handle daemons using systemd. After this, you'll find out how to create shared libraries and start exploring different types of interprocess communication (IPC). In the later chapters, recipes on how to write programs using POSIX threads and how to debug your programs using the GNU debugger (GDB) and Valgrind will also be covered. By the end of this Linux book, you will be able to develop your own system programs for Linux, including daemons, tools, clients, and filters. What you will learn

Discover how to write programs for the Linux system using a wide variety

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of system calls Delve into the working of POSIX functions Understand and use key concepts such as signals, pipes, IPC, and process management Find out how to integrate programs with a Linux system Explore advanced topics such as filesystem operations, creating shared libraries, and debugging your programs Gain an overall understanding of how to debug your programs using Valgrind Who this book is for This book is for anyone who wants to develop system programs for Linux and gain a deeper understanding of the Linux system. The book is beneficial for anyone who is facing issues related to a particular part of Linux system programming and is looking for specific recipes or solutions.

Embedded Systems Architecture is a practical and technical guide to understanding the components that make up an embedded system's architecture. This book is perfect for those starting out as technical professionals such as engineers, programmers and designers of embedded systems; and also for students of computer science, computer engineering and electrical engineering. It gives a much-needed 'big picture' for recently graduated engineers grappling with understanding the design of real-world systems for the first time, and provides professionals with a systems-level picture of the key elements that can go into an embedded design, providing a firm foundation on which to build their skills. Real-world approach to the fundamentals, as well as the design and architecture process, makes this book a popular reference for the daunted or the inexperienced: if in doubt, the answer is in here! Fully updated with new coverage of FPGAs, testing, middleware and the latest programming techniques in C, plus complete source code and sample code, reference designs and tools online make this the complete package Visit the companion web site at

<http://booksite.elsevier.com/9780123821966/> for source code, design examples, data sheets and more A true introductory book, provides a comprehensive get up and running reference for those new to the field, and updating skills: assumes no prior knowledge beyond undergrad level electrical engineering Addresses the needs of practicing engineers, enabling it to get to the point more directly, and cover more ground. Covers hardware, software and middleware in a single volume Includes a library of design examples and design tools, plus a complete set of source code and embedded systems design tutorial materials from companion website

The open source nature of Linux has always intrigued embedded engineers, and the latest kernel releases have provided new features enabling more robust functionality for embedded applications. Enhanced real-time performance, easier porting to new architectures, support for microcontrollers and an improved I/O system give embedded engineers even more reasons to love Linux! However, the rapid evolution of the Linux world can result in an eternal search for new information sources that will help embedded programmers to keep up! This completely updated second edition of noted author Doug Abbott's respected introduction to embedded Linux brings readers up-to-speed on all the latest developments. This practical, hands-on guide covers the many issues of special concern to Linux users in the embedded space, taking into account their specific needs and constraints. You'll find updated information on: • The GNU toolchain • Configuring and building the kernel • BlueCat Linux • Debugging on the target • Kernel Modules • Devices Drivers • Embedded Networking • Real-time programming tips and techniques • The RTAI environment • And much more The accompanying CD-ROM contains all the source code from the book's examples, helpful software and other resources to help you get up to speed quickly. This is still the reference you'll reach for again and again!

* 100+ pages of new material adds depth and breadth to the 2003 embedded bestseller. * Covers new Linux kernel 2.6 and the recent major OS release, Fedora. * Gives the engineer a guide to working with popular and cost-efficient open-source code.

Over the last few years, Linux has grown both as an operating system and a tool for personal and business use. Simultaneously becoming more user friendly and more powerful as a back-end system, Linux has achieved new plateaus: the newer filesystems have solidified, new commands and tools have appeared and become standard, and the desktop--including new

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desktop environments--have proved to be viable, stable, and readily accessible to even those who don't consider themselves computer gurus. Whether you're using Linux for personal software projects, for a small office or home office (often termed the SOHO environment), to provide services to a small group of colleagues, or to administer a site responsible for millions of email and web connections each day, you need quick access to information on a wide range of tools. This book covers all aspects of administering and making effective use of Linux systems. Among its topics are booting, package management, and revision control. But foremost in Linux in a Nutshell are the utilities and commands that make Linux one of the most powerful and flexible systems available. Now in its fifth edition, Linux in a Nutshell brings users up-to-date with the current state of Linux. Considered by many to be the most complete and authoritative command reference for Linux available, the book covers all substantial user, programming, administration, and networking commands for the most common Linux distributions. Comprehensive but concise, the fifth edition has been updated to cover new features of major Linux distributions. Configuration information for the rapidly growing commercial network services and community update services is one of the subjects covered for the first time. But that's just the beginning. The book covers editors, shells, and LILO and GRUB boot options. There's also coverage of Apache, Samba, Postfix, sendmail, CVS, Subversion, Emacs, vi, sed, gawk, and much more. Everything that system administrators, developers, and power users need to know about Linux is referenced here, and they will turn to this book again and again.

The Raspberry Pi makes an ideal match for the Internet of Things. To put it to good use in IoT you need two areas of expertise, electronics and programming and this presents a barrier to getting started. However, there is an overlooked route that can provide a shortcut. Pi OS, the Raspberry Pi's operating system is Linux based and Linux drivers are available for many off-the-shelf IoT devices. These provide a very easy-to-use, high-level way of working. The problem that this book solves is that there is very little documentation to help you get started. In it Harry Fairhead explains the principles so that you can tackle new devices and he also guides you through of using external hardware via standard Linux drivers. Throughout this book you will find a practical approach to understanding electronic circuits and datasheets and translating this to code, specifically using the C programming language. The main reason for choosing C is speed, a crucial factor when you are writing programs to communicate with the outside world and if you are familiar with another programming language, C shouldn't be hard to pick up. After a quick tour of the Raspberry Pi ecosystem, Visual Studio Code (VS Code) and how it can be used to develop remotely, is introduced. The first IoT program anyone writes is "blinky" to flash an LED and this book is no exception, but it might not be quite what you expect. Instead of using a GPIO line it uses the Linux LED driver - no hardware and no fuss. The GPIO isn't left out, however, as the next three chapters focus on its use via the new GPIO character driver, which replaces the old and very common sysfs GPIO driver. This is the way to do modern GPIO. A key component in any look at Linux and its relationship to hardware is the relatively new Device Tree. While most accounts of this resource are aimed at device driver writers, this one is aimed at device driver users and to this end we look at the DHT22 temperature and humidity driver. After a brief detour into some basic electronics, we look at Pulse Width Modulation supported via a driver rather than needing to be implemented using the GPIO. From here we tackle the two standard buses, I2C and SPI, first going through the basics and then looking at the two attempts to impose a higher organization, the hardware monitoring system, Hwmon, and Industrial I/O, IIO.

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The third standard bus, although generally not supported in hardware is the 1-Wire bus. This is covered in detail and even includes an introduction to using Netlink, which uses the sockets API to send messages to and from the kernel to access the driver. The final chapter takes things to the next level and considers creating your own custom overlays by writing fragments to the device tree. Harry Fairhead has worked with microprocessors, and electronics in general, for many years and is an enthusiastic proponent of the IoT. He is the author of Raspberry Pi IoT in C, which has recently been republished in its second edition, updated for Raspberry Pi 4 and co-author of Raspberry Pi IoT in Python Using GPIO Zero. His other recent books include Micro: bit IoT in C, Fundamental C: Getting Closer To The Machine and Applying C For The IoT With Linux.

“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

Harness the power of Linux to create versatile and robust embedded solutions Key Features Learn how to develop and configure robust embedded Linux devices Explore 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 kernel Book Description Embedded Linux runs many of the devices we use every day. From smart

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TVs and Wi-Fi routers to test equipment and industrial controllers, all of them have Linux at their heart. The Linux OS is one of the foundational technologies comprising the core of the Internet of Things (IoT). This book starts by breaking 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 explains 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 learn Use Buildroot and the Yocto Project to create embedded Linux systems Troubleshoot BitBake build failures and streamline your Yocto development workflow Update IoT devices securely in the field using Mender or balena Prototype peripheral additions by reading schematics, modifying device trees, soldering breakout boards, and probing pins with a logic analyzer Interact with hardware without having to write kernel device drivers Divide your system up into services supervised by BusyBox runit Debug devices remotely using GDB and measure the performance of systems using tools such as perf, ftrace, eBPF, and Callgrind Who this book is for If you're a systems software engineer or system administrator who wants to learn Linux implementation on embedded devices, then this book is for you. Embedded systems engineers accustomed to programming for low-power microcontrollers can use this book to help make the leap to high-speed systems on chips that can run Linux. Anyone responsible for developing new hardware that needs to run Linux will also find this book useful. Basic working knowledge of the POSIX standard, C programming, and shell scripting is assumed.

Master the art of developing customized device drivers for your embedded Linux systems Key Features Stay up to date with the Linux PCI, ASoC, and V4L2 subsystems and write device drivers for them Get to grips with the Linux kernel power management infrastructure Adopt a practical approach to customizing your Linux environment using best practices Book 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

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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 learn Explore and adopt Linux kernel helpers for locking, work deferral, and interrupt management Understand the Regmap subsystem to manage memory accesses and work with the IRQ subsystem Get to grips with the PCI subsystem and write reliable drivers for PCI devices Write full multimedia device drivers using ALSA SoC and the V4L2 framework Build power-aware device drivers using the kernel power management framework Find out how to get the most out of miscellaneous kernel subsystems such as NVMEM and Watchdog Who 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.

Expand Raspberry Pi capabilities with fundamental engineering principles Exploring Raspberry Pi is the innovators guide to bringing Raspberry Pi to life. This book favors engineering principles over a 'recipe' approach to give you the skills you need to design and build your own projects. You'll understand the fundamental principles in a way that transfers to any type of electronics, electronic modules, or external peripherals, using a "learning by doing" approach that caters to both beginners and experts. The book begins with basic Linux and programming skills, and helps you stock your inventory with common parts and supplies. Next, you'll learn how to make parts work together to achieve the goals of your project, no matter what type of components you use. The companion website provides a full repository that structures all of the code and scripts, along with links to video tutorials and supplementary content that takes you deeper into your project. The Raspberry Pi's most famous feature is its adaptability. It can be used for thousands of electronic applications, and using the Linux OS expands the functionality even more. This book helps you get the most from your Raspberry Pi, but it also gives you the fundamental engineering skills you need to incorporate any electronics into any project. Develop the Linux and programming skills you need to build basic applications Build your inventory of parts so you can always "make it work" Understand interfacing, controlling, and communicating with almost any component Explore advanced applications with video, audio, real-world interactions, and more Be free to adapt and create with Exploring Raspberry Pi.

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