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Albert S. Huang and Larry Rudolph
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Bluetooth Essentials for Programmers

This book provides an introduction to Bluetooth programming, with a specific focus on developing real code. The authors discuss the major concepts and techniques involved in Bluetooth programming, with special emphasis on how they relate to other networking technologies. They provide specific descriptions and examples for creating applications in a number of programming languages and environments, including Python, C, Java, GNU/Linux, Windows XP, Symbian Series 60, and Mac OS X. No previous experience with Bluetooth is assumed, and the material is suitable for anyone with some programming background. The book places special emphasis on the Python language examples, showing the translation of concepts and techniques into actual working programs. Programmers who have never seen or used Python before will find these examples easy to follow and understand.

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Preface

About This Book

This book provides an introduction to Bluetooth wireless technology* and Bluetooth programming, with a specific focus on the parts of Bluetooth that concern a software developer. While there is already a host of existing literature about Bluetooth, few of these texts are written for the programmer who is concerned primarily with creating Bluetooth software applications. Instead, they tell all about Bluetooth, when most of the time, the programmer is interested only in a tiny fraction of this information.

This book purposefully and happily leaves out a great deal of information about Bluetooth. Concepts are simplified and described in ways that make sense to a programmer, not necessarily the ways they're laid out in the Bluetooth specification. The approach is to start simply, allowing the reader to quickly master the basic concepts with the default parameters before addressing a few advanced features.

Despite these omissions, this book is a rigorous introduction to Bluetooth, albeit with a narrow focus. Applications can be developed without an understanding of the radio modulation techniques or the algorithms underlying the generation of Bluetooth encryption keys. Programmers, however,

* Throughout this book, we will abbreviate the phrase "Bluetooth wireless technology" with the concise word "Bluetooth."

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do need to understand issues such as the available transport protocols, the processes governing establishing connections, and the mechanisms for transferring data.

We strongly believe in learning by example and have included working programs that demonstrate the concepts and techniques introduced in the text.* Examples are provided for a wide variety of programming languages and environments, including Python, C, and Java, running on GNU/Linux, Windows, Nokia Series 60, and OS X. Special emphasis is given to the Python language examples – the simplicity and clarity of Python allows us to very easily show the translation of concepts and techniques into actual working programs. We believe that programmers who have never seen or used Python will find these examples easy to follow and understand.

This book is not meant to be a be-all and end-all guide to Bluetooth programming; rather it is meant to serve as a stepping stone, the first foothold for programmers interested in working with Bluetooth. The exposition of concepts and demonstration of techniques should be sufficient to allow any programmer to start creating his or her own functional Bluetooth applications that can interoperate with many other Bluetooth devices. For those interested in a deeper understanding of the inner workings and nitty-gritty details of Bluetooth, this book serves as sufficient preparation to enable one to tackle the more complex and technical documents like the Bluetooth specification itself.

Audience

This book targets the computer programmer looking for an introduction to Bluetooth and how to program with it. It assumes no previous knowledge of Bluetooth (you may have never even heard of it before picking up this book), but does assume that you have some programming experience and have access to and can use either a GNU/Linux, Windows XP, or OS X development environment.

Because Bluetooth programming shares much in common with network programming, there will be frequent references and comparisons to concepts in network programming, such as sockets and the TCP/IP transport protocols. A basic understanding of these concepts will help solidify your understanding

* Visit our Web site to download the examples in the book. Check updates, errata, and new material: www.btessentials.com or www.cambridge.org/9780521703758.

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of Bluetooth programming, but the text is written such that it does not assume the reader has this knowledge.

Organization of This Book

- Chapter 1** provides an introduction to Bluetooth and the essentials of Bluetooth programming. The first chapter is divided into two major sections. The first section can be considered the bare essentials, most of which must be understood in order to create a functional Bluetooth program. The second section is material that is highly relevant to the Bluetooth programmer, but is not of critical importance when creating simple Bluetooth programs.
- Chapter 2** shows how the concepts and techniques introduced in Chapter 1 can be implemented in the Python programming language using the Py-Bluez extension module. The simplest examples (Device Discovery, Service Search, and RFCOMM) work on both GNU/Linux and Windows XP SP2 computers, and a few examples require a GNU/Linux computer. This chapter allows the programmer to quickly and easily create fully functional Bluetooth programs with minimal effort.
- Chapter 3** describes in detail how to create Bluetooth applications targeted for the GNU/Linux operating system. Programming examples are given in C, and require the BlueZ stack, which is now a part of the standard Linux kernel. Device Discovery, Service Search, RFCOMM, L2CAP, HCI, and SCO are described.
- Chapter 4** describes the current state of Bluetooth programming in Windows XP. A detailed introduction is then given for the Microsoft Bluetooth stack, which comes standard in Windows XP SP2 (and is expected to be present in Windows Vista as well). Examples are given for Device Discovery, Service Search, and RFCOMM.
- Chapter 5** describes how to create Bluetooth applications using the Java programming language. JSR-82, the standard Java API for Bluetooth programming, is introduced along with examples for Device Discovery, Service Search, RFCOMM, and L2CAP.
- Chapter 6** provides a partial introduction to Bluetooth programming on the Nokia Series 60 and OS X operating systems. The Series 60 Python Bluetooth API is described with examples for Device Discovery, Service Search, and RFCOMM. Device Discovery and outgoing RFCOMM connections using the OS X Objective C Bluetooth API are introduced with examples. Lastly, Bluetooth serial ports are introduced as an alternative to standard

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Bluetooth programming. Bluetooth programming using RFCOMM serial ports is described along with its merits and drawbacks. Examples are given for GNU/Linux, Windows XP, and OS X.

Chapter 7 introduces a series of GNU/Linux Bluetooth development tools that are indispensable for the serious Bluetooth developer. Although these tools are built only for the GNU/Linux operating system, Bluetooth programmers creating applications targeted for other platforms may still find these tools highly useful.

Acknowledgments

A large number of people made valuable contributions to this text. Marcell Holtmann and the BlueZ developers provided outstanding support throughout our trials and tribulations with Bluetooth. Simson Garfinkel and Yotam Gingold provided advice on the OS X section. Sally Lee has been absolutely wonderful with her assistance on the production of the text. Angela Hsieh provided the cover artwork ^.^ Heather Bergman, Pooja Jain, and the rest of Cambridge University Press have been fantastic with their guidance and support. Kari Pulli, Jamey Hicks, and Max Van Kleek provided numerous bits of insight and advice. The following students in the Oxygen Research Group have also been of great help: Ning Song, Calvin On, Emily Yan, Atish Nigam, Sonia Garg, Debbie Wan, Michael D'Ambrosio, Nancy Kho, Xiao Yu, and Jessica Hwang. Finally, Sally Lee deserves lots of thanks for her helpful advice in nearly all aspects of this work.

We would also like to thank the MIT Project Oxygen, Nokia, and the Singapore–MIT alliance for their support of the work that eventually led to the writing of this book.

Albert's Personal Comments

This book grew out of my master's thesis work with Larry on Bluetooth and location-aware computing. During that time, it was difficult to find good documentation and introductory material suitable for someone with a computer science background. I started writing what I figured out and in a way that I would have loved to have had when I first started out. Like many endeavours, we weren't sure how it would turn out and if anybody would actually read

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it. But my hope is that this book will help lower the entry bar for working with Bluetooth.

All of this would not have been possible without the love and support of my family, friends, and colleagues. Most of all, I'd like to thank Stacy, my parents, my sister Heather, and Jen. Thank you for everything.

Larry's Personal Comments

A book is a large undertaking and in the case of this book, it was like trying to fit a square block into a round pinhole. All of my time has been allocated to family, teaching, advising, and research, but somehow time was found for this enterprise. Albert did the bulk of the work and deserves the bulk of the credit. I merely managed the work. Nevertheless, because of this project, I spent less time with my family and so would like to give my thanks to Hilla, Noga, and Amit, as well as to Ainat.

The need for a programming guide became evident over a half a dozen years ago when Sonia Garg valiantly struggled to control Bluetooth devices in a nonstandard way as part of our research. Without her persistence, it is likely that I would have avoided any future attempt to deal with Bluetooth. The MIT Project Oxygen got me involved in pervasive, human-centric computing, and deserves a lot of thanks. In addition, I would like to thank my friends at Nokia and the Nokia Research Center. Finally, I want to thank CSAIL, the Computer Science and Artificial Intelligence Laboratory, at MIT.