RFID FOR DUMMIES®

by Patrick J. Sweeney II

Wiley Publishing, Inc.

RFID FOR DUMMIES®

RFID FOR DUMMIES®

by Patrick J. Sweeney II

Wiley Publishing, Inc.

RFID For Dummies®
Published by
Wiley Publishing, Inc.
111 River Street
Hoboken, NJ 07030-5774
www.wiley.com

Published by Wiley Publishing, Inc., Indianapolis, Indiana

Published simultaneously in Canada

Library of Congress Control Number: 2005921609

ISBN: 0-7645-7910-X

Manufactured in the United States of America

10 9 8 7 6 5 4 3 2 1

1O/RU/QT/QV/IN

About the Author

As you may have guessed by the dangling participles and misused gerunds, this is the first book by **Patrick J. Sweeney II** (despite Amazon's link to books on gynecology by an author of the same name). When not negotiating with his editor to push back book deadlines, he leads ODIN technologies as President and CEO.

ODIN technologies is a global RFID software and services company focusing on RFID infrastructure. Mr. Sweeney is well recognized as a visionary in the RFID industry with several RFID patents in various stages of approval. He has appeared in such publications as *CIO Magazine, The Washington Post, Fortune* magazine, *Internet Week,* and many others. He has been interviewed by ABC news and CNN, among others, and is a frequent speaker worldwide on all topics relating to RFID. He is also an active member of several standards bodies and regulatory groups helping to shape the evolution of the RFID industry.

Mr. Sweeney is a second-generation IT professional; his father was one of the first employees at Electronic Data Systems (EDS), where "Pops" entertained him and his brother on weekends by teaching them to read punch cards and other useful skills. Mr. Sweeney took that genetic proclivity toward data centers and started a successful, secure managed hosting company in the late 1990s, which he later sold. His brother took that same early training and started XS Speed Choppers, making custom motorcycles — go figure.

Mr. Sweeney finished second in the 1996 Olympic trials in the single scull, is an avid outdoorsman, enjoys helping other entrepreneurs, and is passionate about various Irish causes. He is a board member of Trinity College business school in Dublin, Ireland, and an Alumni Board member at the Darden School of Business at the University of Virginia. He graduated from Darden and received a Bachelor of Science degree from the University of New Hampshire. He is blessed with a great family—wife Christen, daughter Shannon, son P.J., and three dogs. They live in Middleburg, Virginia, in a house full of useless RFID gadgets.

Dedication

This book is dedicated to everyone who makes the dream of entrepreneurship and innovation possible, from the brave men and women defending our freedom in the armed forces, police, and fire departments to college professors, mentors, and angel investors.

Topping the list of people who make entrepreneurship (and crazy book projects) possible are loving, understanding, and helpful spouses like mine. This book is especially dedicated to my beautiful wife Christen, who helps and supports me as I build companies, write books, and travel around the world chasing birds and the Red Sox.

Author's Acknowledgments

First and foremost my family gets a big thanks for letting me bang away on the laptop during dinner, in bed, and at other times made awkward because an electronic device is the center of my world instead of them. Thanks Betty, Shannon, and P.J.!

The book flow, formatting, and funniness (I recently learned that there is called *alliteration*) is largely due to the great work of Becky Huehls at Wiley who was my project editor and learned me all sorts of interesting things about writing.

Of course the book wouldn't even be possible if not for the guys in ODIN technologies labs; Bret, Charles, Nick, Ray, Dave, and the rest of the crew played an invaluable role, and they deserve a ton of updog.

I could not have written such a comprehensive book on this diverse technology without significant contributions from some first-class industry experts. Many of these folks contributed an entire chapter to the book, so although the pronoun "I" is used throughout the book to stay consistent with Wiley's *For Dummies* style, much of the credit goes to an amazing team of contributors:

Earl Cox
Scianta Intelligence
www.scianta.com
www.autoidlabsus.org

Daniel Engels, Ph.D.
Robert Goodman
Yankee Group
www.yankee.com

Pat King, Ph.D.
Bob Brescia
Michelin US
www.michelin.com

Sharyn Leaver
Forrester
www.forrester.com

Chris Fennig
ODIN technologies
www.odintechnologies.com

I also thank God for blessing me with great family and friends who helped me get to a position where taking on this project became a reality. Thanks Mom and Pops, Blanche, MAF, Jimbo, Shelley, Rusty, Vas and Linda, Chris and Kate, Gregg, John M, David B, Robert, Zohar and Sam, Bernard, Charles, Murph, Melchoir, Bo, Dr. R, and everyone else who helped me get here.

Publisher's Acknowledgments

We're proud of this book; please send us your comments through our online registration form located at www.dummies.com/register/.

Some of the people who helped bring this book to market include the following:

Acquisitions, Editorial, and Media Development

Project Editor: Rebecca Huehls

Acquisitions Editor: Melody Layne

Copy Editor: Andy Hollandbeck

Technical Editor: Christopher Bratten

Editorial Manager: Leah P. Cameron

Media Development Manager: Laura VanWinkle

Media Development Supervisor: Richard Graves

Editorial Assistant: Amanda Foxworth

Cartoons: Rich Tennant, www.the5thwave.com

Composition Services

Project Coordinators: Adrienne Martinez, Emily Wichlinski

Layout and Graphics: Carl Byers, Andrea Dahl, Lauren Goddard, Denny Hager, Joyce Haughey, Lynsey Osborn, Melanee Prendergast

Proofreaders: Laura Albert, Leeann Harney, Jessica Kramer, Linda Morris, Carl William Pierce

Indexer: TECHBOOKS Production Services

Special Help: Kim Darosett, Teresa Artman

Publishing and Editorial for Technology Dummies

Richard Swadley, Vice President and Executive Group Publisher

Andy Cummings, Vice President and Publisher

Mary Bednarek, Executive Acquisitions Director

Mary C. Corder, Editorial Director

Publishing for Consumer Dummies

Diane Graves Steele, Vice President and Publisher

Joyce Pepple, Acquisitions Director

Composition Services

Gerry Fahey, Vice President of Production Services

Debbie Stailey, Director of Composition Services

Contents at a Glance

Table of Contents

Introduction

Somewhere, separated from you by just a few degrees, is not Kevin Bacon, but an 800-pound gorilla demanding that you adopt radio frequency identification, or RFID — a technology you may have never even heard of until just a few months ago. Chances are that gorilla wears a stylish blue smock with a yellow smiley face on it and greets you with a "Welcome to Wal-Mart." If not Wal-Mart, the US Department of Defense, Target, Albertsons, Best Buy, Tesco, Metro, the FDA or a number of other companies may be requiring you to implement this technology by a certain deadline. If you don't have a mandated deadline for adopting RFID, consider yourself lucky. You can discover and make decisions about this exciting technology based on your normal process for evaluating new business tools.

Whatever your situation is, you either want or need to set up an RFID network. So you went out and picked up *RFID For Dummies* and are ready to go — yippee!

About This Book

This is a book that is on a mission to take the confusion out of RFID. RFID is based on well-known laws of physics. It's easy to understand how things work after you get your arms around those basics. The better news is that the technology works really well if you know what you're doing. So without sending you to MIT for a couple of years of RF engineering school, this book explains everything you need to know to start setting up and deploying your own RFID network — what more could you ask for?

Who This Book Is For

Whether you are just curious, scared, worried, or simply mad at the prospect of implementing yet another new technology — even if you know nothing about RFID — *RFID For Dummies* is here to help. And, unlike a similar promise by the IRS, this book really will help. You find out what RFID is, what it does, and how it works. I guide you through the concepts and ideas in plain English, walk you through the basics of RFID from a business perspective, and speculate on where this technology is headed (although I do, from time to time,

provide sufficient Geek Speak for the engineers and systems guys who, no doubt reluctantly, bought this book in an attempt to actually understand the mechanics of Radio Frequency Identification).

If you know the basics about running a laptop or PC and know what an IP address is, you are armed with just about all you need to know to initially set up an RFID network. If you have any background in physics and understand some things from an electronics perspective, you've got a running start. I assume that you come from a supply chain or warehouse background and might not have a detailed IT background.

You Don't Need a Slide Rule and Pocket Protector to Use This Book

Other than the willingness to learn and basic knowledge, you need some equipment to set up your RFID network and follow some of the processes outlined in this book. At some point, plan to get

- A spectrum analyzer (discussed in Chapter 8)
- A budget to buy an RFID reader, antennas, tags, and a rack (about $7,500 total)
- An area large enough to begin testing and using the equipment (at least 20 feet x 20 feet)
- Another person to help you occasionally try out the technology
- A penchant for experimentation and thirst for knowledge

How This Book Is Organized

RFID For Dummies is broken into six different parts. If you are new to the technology, it is helpful to read the parts in sequential order. If you have a physics or RF background and you want to get into the nuts and bolts of the technology, skip right to Part II and then move on to Part III. If you are trying to justify the RFID project, you may want to go right to Part V, which addresses some of the business concerns around strategic planning and ROI. You can read all the technical chapters in Parts II and III by themselves and use them for reference, as well as the last part, the Part of Tens. Here's a quick rundown of what you'll find in each part.

Part I: Now That You Can Spell RFID, Here's the Rest of the Story

This part introduces the basics of RFID. In Chapter 1, you find an overview of the technology, what advantages are driving the mandates, and a blueprint for implementing RFID, which I call the four Ps. In Chapter 2, I explain how RFID fits into the world of Auto-ID technology and explain some of the basics about the protocols that make it work. Chapter 3 helps you start assessing the impact RFID will have on your business and helps you make some basic decisions about how you'll use RFID.

Part II: Ride the Electromagnetic Wave: The Physics of RFID

In this part, I peel away the layers of RFID to uncover the underlying science of RFID. This part gives you the physics knowledge you need in order to design your network for optimal performance and make wise purchases. In Chapter 4, you can find an overview of how the physics of RFID systems work. Chapter 5 digs a little deeper by delving it parts inside each of the key components of a system. Whereas Chapters 4 and 5 focus on the invisible realm of electromagnetic waves, Chapter 6 is focused squarely in warehouse or marketplace, covering common setups of RFID systems and case studies so that you can learn from early adopters.

Part III: Fitting an RFID Application into Your World

This part is your key to designing an RFID network specifically for your environment and needs. In Chapter 7, I walk you through the process of testing for electromagnetic noise in your warehouse or building using a spectrum analyzer. Chapter 8 helps you set up a lab (or find one you can use) so that you test for the right tag (Chapter 9) and tag reader (Chapter 10). And last but not least, Chapter 11 helps you wend your way through maze of *middleware* (the software the connects the RFID network) by explaining what features to look for and how to fit middleware into your network architecture.

Part IV: Raising the Beams for Your Network

This part walks you through the process of actually implementing your carefully planned-out RFID network. Chapter 12 explains a few project management tools that will keep your trial run and follow-up network designs on schedule. Chapter 13 covers the process of setting up the hardware in the warehouse, or other real-world setting (as opposed to a lab), and how to train your employees to use the new system. And Chapter 14 explains now to set up monitoring systems for both operators and system administrators, so that your system keeps running strong, and thus helps your bottom line.

Part V: How to Speak Bean Counter

Deploying an RFID system is a big project, and the bottom line needs to drive your implementation. This part walks you through the key RFID-related business decisions you need to make. In Chapter 15, I explain who in your organization needs to be involved in these decisions and walk you through a nine-step process for building and presenting a business case study. In Chapter 16, I explain strategic benefits you need to include in the business case in more detail, including how to calculate return on investment, or ROI, for all the money you're about to spend on RFID hardware and software. Chapter 17 is your guide to outsourcing: I explain how you decide whether to outsource, what to look for in an outsourcing partner, and how to seal the deal.

Part VI: The Part of Tens

No *For Dummies* book is complete without a Part of Tens. The four chapters in this part offer (more or less) ten equipment vendors to assess, ten of the best RFID-related Web sites, ten tips from RFID experts who are part of that rare fraternity that has actually done real-world deployments and lived to tell about it, and ten standards and protocols for RFID that you may want to investigate.

In the back of this book, you can also find a glossary of electrical, magnetic, and scientific terms. So if, in your RFID reading, you come across terminology that leaves you baffled, you can use this glossary as a handy resource.

Icons Used in This Book

Throughout this book, you find icons in the margins, marking specific paragraphs. Here's what those icons indicate:

The Tip icon marks tips and shortcuts that you can use to make your RFID installation, testing, and implementation easier.

Remember icons mark the information that's especially important to know. To siphon off the most important information in each chapter, just skim through these icons.

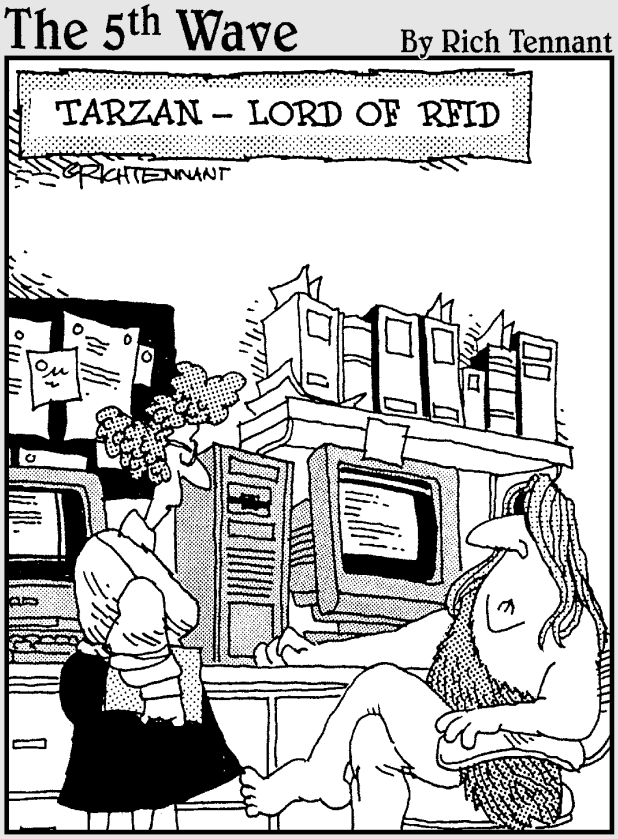
The Technical Stuff icon marks information of a highly technical nature that you can normally skip over unless you have a closet desire to geek out on radio frequency. But face it: If you're reading about RFID, you're probably a technical-minded person. If this is the case, you're more likely to skip *to* this icon instead of skipping *over* it.

The Warning icon tells you to watch out! It marks important information that may save you headaches, long talks with government officials, and maybe even bodily injury.

The Case Study icon points out real-life examples of how RFID has been used (and misused) in the marketplace.

Part I

Now That You Can Spell RFID, Here's the Rest of the Story



"... and then one day it hit Tarzan, Lord of Jungle – where future in that?"

In this part . . .

Part I gets you prowling down the path to RFID adoption. In these three chapters, you become acquainted with the basics of the technology and understand how it compares to other automatic identification (Auto-ID) technologies. I explain why RFID has blossomed into the latest and greatest technology since the electric toaster. You also find out why so many people need to adopt this technology in such a short period of time.

The last chapter of Part I shows you, in simple, easy-to-understand terms, how to compare the different RFID networking and technology systems. This serves as a primer for more detailed discussions later in the book.

Chapter 1

Taking the Mystery out of RFID

In This Chapter

- Discovering RFID
- Getting a handle on the technology
- Figuring out what you need to know
- Knowing what to expect in the future

With all the recent hype over radio frequency identification (RFID) and the requirements to implement it, you might think that RFID can turn water into wine, transform lead into gold, and cure the world's diseases. You might also be worried that RFID will enable Big Brother to track your movements to within a foot of your location from a satellite five hundred miles up in space. The truth is, RFID can do none of these things.

In this chapter, you find out the basics of what RFID is, what forces are driving RFID as a replacement for the bar code in the marketplace, and what benefits RFID can offer.

If you are responsible for complying with high-profile mandates from one of your suppliers or customers, this chapter also offers a framework to help you begin setting up a system and making it work within your existing business process. The bad news is that an RFID implementation is a daunting project even at a minimal compliance level, sometimes referred to as *slap and ship* or, more appropriately, *tag and ship.* The good news is that the benefits to the business are substantial, particularly if your trading partners are involved. RFID technology is here to stay, so the sooner you understand it, the quicker you can make key strategic decisions for your company.

What Is RFID?

RFID is a very valuable business and technology tool. It holds the promise of replacing existing identification technologies like the bar code. RFID offers strategic advantages for businesses because it can track inventory in the supply chain more efficiently, provide real-time in-transit visibility (ITV), and monitor general enterprise assets. The more RFID is in the news, the more

creative people are about its potential applications. For example, I recently heard from someone who wanted to use RFID to track fishing nets in the North Sea.

The origins of RFID in inventory tracking

Wal-Mart has spent millions of dollars since the late 1990s researching the efficacy of RFID systems to replace bar codes (which have been in use since the days of *The Brady Bunch* and *Gilligan's Island* — that's the early 1970s, for those of you with all your hair left).

In 1999, with the help of scientists at the Massachusetts Institute of Technology (MIT), a consortium of companies formed the Auto-ID Center — a center for continued research into the nature and use of radio frequency identification. The consortium had a new idea about how organizations could identify and track their assets. The vision underlying automatic identification (or Auto-ID) is the creation of an "Internet of Objects." In such a highly connected network, devices dispersed through an enterprise can talk to each other — providing real-time information about the location, contents, destination, and ambient conditions of assets. This communication allows much-sought-after machine-to-machine communication and decision-making, rendering humans unnecessary and mistakes a thing of the past.

Today, Auto-ID can track not only enterprise assets, but also the movement of products, containers, vehicles, and other assets across vast geographic areas. For more about the Auto-ID Center and the current organizations involved in developing RFID technology, see Chapter 2.

Tracking goods with EPC codes

RFID is actually nothing new. Just as goods today have bar codes, goods in RFID systems have codes that enable systems to share information. Because the mandated RFID systems require businesses to share information with each other, the different systems need to use the same code — the electronic product code (EPC). The EPC is the individual number associated with an RFID tag or chip.

The EPC was developed at MIT's Auto-ID Center in 2000 and is a modern-day replacement for the Universal Product Code (UPC). A tag's embedded EPC number is unique to that tag. However, the EPC *protocol* is universal to all EPC-compliant systems and serves two specific functions:

- Telling how data is to be segregated and stored on the tag, or what is also known as the *numbering scheme*.
- Determining how the tags and readers communicate (also called the *air interface protocol*).