Virtualization FOR DUMMIES®

by Bernard Golden

Wiley Publishing, Inc.

Virtualization FOR DUMMIES®

Virtualization FOR DUMMIES®

by Bernard Golden

Wiley Publishing, Inc.

Virtualization 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: 2007940109

ISBN: 978-0-470-14831-0

Manufactured in the United States of America

10 9 8 7 6 5 4 3 2 1

About the Author

Bernard Golden has been called "a renowned open source expert" (IT Business Edge) and "an open source guru" (SearchCRM.com) and is regularly featured in magazines like *Computerworld, InformationWeek,* and *Inc.* His blog "The Open Source" is one of the most popular features of CIO Magazine's Web site. Bernard is a frequent speaker at industry conferences like LinuxWorld, the Open Source Business Conference, and the Red Hat Summit. He is the author of *Succeeding with Open Source,* (Addison-Wesley, 2005, published in four languages), which is used in over a dozen university open source programs throughout the world. Bernard is the CEO of Navica, a Silicon Valley IT management consulting firm.

Dedication

To Sebastian and Oliver, the bright stars Kocab and Pherkad, Guardians of the Pole of the Golden family constellation. May your lives be blessed in the ways you've blessed mine.

Author's Acknowledgments

So many people have helped in the writing of this book that it would be justified in calling it a collaboration of the willing. Their enthusiasm in sharing information and perspective has been invaluable. I'd like to thank everyone who offered help and encouragement and to especially thank the following:

Kyle Looper and Paul Levesque of Wiley Publishing, Inc., who gently yet irresistibly pushed me toward finishing the book. Kyle generously contracted for the book, and Paul affably helped shape it in the direct and comprehensible *For Dummies* style.

David Marshall, who performed the key duty of technical reviewer for the book, providing much valuable feedback. David is a real virtualization guru who writes the weekly virtualization newsletter for InfoWorld and also works at the virtualization startup Inovawave.

From HP: Andy Scholl helped me comprehend HP's myriad of virtualization technologies and products.

From IBM: Chris Almond, Greg Kelleher, Jerone Young, and Bob Zuber helped me comprehend this very large organization's various virtualization initiatives, and I appreciate their assistance.

From Novell: Jonathan Ervine, Kerry Kim, and Justin Steinman provided insight about Novell's virtualization objectives and technology.

From Platespin: Richard Azevedo and Bojan Dusevic were very generous and helpful with their time, much appreciated in helping me sort out the complex topic of P2V migration.

From Red Hat: Joel Berman, Nick Carr, Jan Mark Holzer, Rob Kenna, and Brian Stevens all very generously shared their time and expertise, especially aiding with the Fedora hands-on chapter.

From Sun: Joanne Kisling, Chris Ratcliffe, Paul Steeves, Joost Pronk van Hoogeveen, and Bob Wientzen described Sun's virtualization efforts and clarified Sun's future plans.

From VMware: Joe Andrews, Bogomil Balkansky, and Melinda Wilken were extremely helpful in understanding the different components and products that incorporate the VMware technology.

From XenSource: John Bara, Christof Berlin, Peter Blum, Simon Crosby, and Roger Klorese helped enabled me to describe the Xen architecture and technology.

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 and Editorial

Senior Project Editor: Paul Levesque

Acquisitions Editor: Kyle Looper

Copy Editor: Virginia Sanders

Technical Editors: David Marshall

Editorial Manager: Leah Cameron

Editorial Assistant: Amanda Foxworth

Sr. Editorial Assistant: Cherie Case

Cartoons: Rich Tennant (`www.the5thwave.com`)

Composition Services

Project Coordinator: Kristie Rees

Layout and Graphics: Reuben W. Davis, Alissa Ellet, Melissa K. Jester, Barbara Moore, Christine Williams

Proofreaders: Laura L. Bowman, John Greenough

Indexer: Ty Koontz

Anniversary Logo Design: Richard Pacifico

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

Foreword xvii

Introduction 1

Part I: Getting Started with a Virtualization Project 7

Chapter 1: Wrapping Your Head around Virtualization 9
Chapter 2: Making a Business Case for Virtualization 33
Chapter 3: Understanding Virtualization: Technologies and Applications 49
Chapter 4: Peeking at the Future of Virtualization 83

Part II: Server Virtualization 99

Chapter 5: Deciding Whether Server Virtualization Is Right for You 101
Chapter 6: Performing a Server Virtualization Cost-Benefit Analysis 111
Chapter 7: Managing a Virtualization Project 129
Chapter 8: Choosing Hardware for Your Server Virtualization Project 159

Part III: Server Virtualization Software Options 187

Chapter 9: Migrating to Your New Virtualized Environment 189
Chapter 10: Managing Your Virtualized Environment 209
Chapter 11: Creating a Virtualized Storage Environment 221

Part IV: Implementing Virtualization 243

Chapter 12: Implementing VMware Server 245
Chapter 13: Implementing Fedora Virtualization 267
Chapter 14: Implementing XenExpress 291

Part V: The Part of Tens 319

Chapter 15: Ten Steps to Your First Virtualization Project 321
Chapter 16: Ten Virtualization Pitfalls to Avoid 329
Chapter 17: Ten Great Resourceson Virtualization 335

Index 341

Table of Contents

Foreword xvii

Introduction 1

Why Buy This Book? 2
Foolish Assumptions 2
How This Book Is Organized 3
Part I: Getting Started with a Virtualization Project 3
Part II: Server Virtualization 4
Part III: Server Virtualization Software Options 4
Part IV: Implementing Virtualization 5
Part V: The Part of Tens 5
Icons Used in This Book 5
Where to Go from Here 6

Part I: Getting Started with a Virtualization Project 7

Chapter 1: Wrapping Your Head around Virtualization 9

Virtualization: A Definition 10
Why Virtualization Is Hot, Hot, Hot — The Four Drivers of Virtualization 11
Trend #1: Hardware is underutilized 11
Trend #2: Data centers run out of space 13
Trend #3: Energy costs go through the roof 14
Trend #4: System administration costs mount 15
Four trends mean virtualization is hot 16
Sorting Out the Types of Virtualization 16
Client virtualization 17
Server virtualization 20
Storage virtualization 28
Creating the Virtualized Enterprise 31

Chapter 2: Making a Business Case for Virtualization 33

Virtualization Lowers Hardware Costs 34
When servers just coast along 35
A handy (if anonymous) real-world example 36

Virtualization Increases IT Operational Flexibility 37
Virtualization's promise 38
A handy (named) example 39
Virtualization Reduces IT Operations Costs 41
Virtualization makes hardware maintenance and upgrades easier and cheaper 41
Virtualization means fewer servers and lower IT costs 43
Virtualization Lowers Energy Costs 44
Software Licensing Costs: A Challenge for Virtualization 45
General software licensing practices 46
Software licensing meets virtualization 47

Chapter 3: Understanding Virtualization: Technologies and Applications 49

Virtualization Technologies 50
Operating system virtualization 51
Hardware emulation 54
Paravirtualization 57
Assessing the implications of virtualization technology 61
Virtualization Applications 62
Development and testing 62
Training 65
Server consolidation 67
Failover/high availability/load balancing 69
Products for failover/high availability/clustering/load balancing: The usual suspects 75
Future directions in high availability 75
Server pooling 76
Disaster recovery 77

Chapter 4: Peeking at the Future of Virtualization 83

Virtualization Gets Integrated into Operating Systems 84
Virtualized Software: Delivered to Your Door Preinstalled 85
The software installation headache 86
The virtual appliance: Oh, what a relief it is! 87
Virtualization Diffusing into the Internet 90
Software as a Service (SaaS) 90
Ever more virtualization = ever less hardware 91
The Changing Skill Set of IT Personnel 93
Software Pricing: How Will It Respond to Virtualization? 95

Part II: Server Virtualization 99

Chapter 5: Deciding Whether Server Virtualization Is Right for You 101

How to Decide Whether You Should Use Server Virtualization 102
Figuring out whether virtualization is right for your organization 102
Looking for clear financial benefits 103
Checking to see whether important prerequisite conditions are in place 103
When Not to Use Virtualization 106
When your computing environment is static 106
When your software providers refuse support within a virtualized infrastructure 107
When your applications don't lend themselves to virtualization 107
When your organization is unwilling to invest to improve operations 110

Chapter 6: Performing a Server Virtualization Cost-Benefit Analysis 111

Getting Your Cost-Benefit Ducks in a Row 111
Defining a solution 112
Looking at current costs 112
Identifying virtualization costs 116
Identifying the financial benefits of virtualization 119
Creating your virtualization cost-benefit spreadsheet 122
The Cost-Benefit Bottom Line 127

Chapter 7: Managing a Virtualization Project 129

Understanding the Virtualization Life Cycle 130
Planning your virtualization journey 131
Implementing your virtualization solution 132
Operating your virtualization solution 133
Creating Your Virtualization Plan 134
Identify your use cases 134
Evaluate your organizational structure 137
Select your architecture 139
Implementing Your Virtualization Solution 142
Confirming your planning assumptions and conclusions 143
Choosing your virtualization software product(s) 144
Choosing your virtualization hardware 145
Performing a pilot implementation 148
Migrating to your production virtualization environment 152
Administering your new virtualized infrastructure 154

Chapter 8: Choosing Hardware for Your Server Virtualization Project 159

Taking Hardware Seriously 160
The multiple-eggs-in-one-basket syndrome 163
The Big Four resources of servers 164
The big four resources — the story so far 174
Choosing Servers 175
Reusing your existing 32-bit hardware 176
Using 64-bit servers 178
Designed for virtualization: The new generation of servers 180
Making the Hard Hardware Choices 181
But Wait, There's More: Future Virtualization Hardware Development 183
Virtualization-enabled chips 183
More efficient memory 184
Faster networking for virtualized machines 184
Better device support in virtualized systems 186

Part III: Server Virtualization Software Options 187

Chapter 9: Migrating to Your New Virtualized Environment 189

Moving from Physical to Virtual: An Overview 190
Getting Ready to Move: Preparing the Virtualized Environment 191
Preparing existing systems for migration 192
Preparing the new virtualization servers 193
Install necessary infrastructure (hardware and software) 197
Migrating Your Physical Servers 200
Manual migration: The hands-on approach 202
Automated migration: Let software do the work 203
Moving to Production 207

Chapter 10: Managing Your Virtualized Environment 209

Managing Virtualization: The Next Challenge 211
Managing Free Virtualization 212
Virtualization Management: The Two Philosophies 213
Virtualization as a specialized resource 214
Virtualization as an equal member of the data center 215
Making Sense of Virtualization Management 217
Where you are in the virtualization journey 217
Your current system management approach 218
What your current hardware mix looks like 219
Deciding on Your Virtualization Management Approach 220

Chapter 11: Creating a Virtualized Storage Environment 223

Storage Overview 223
What the heck is DAS? 224
Shared storage 226
Why use shared storage? 228
LUNS and RAID 228
Data redundancy 230
Cost implications of storage 231
Choosing Storage for Virtualization 231
DAS and virtualization 231
Shared storage and virtualization 234
Storage and the Different Types of Virtualization 236
Operating system virtualization(containers) 236
Hardware emulation virtualization 237
Paravirtualization 238
Storage and the Virtualization Journey 239

Part IV: Implementing Virtualization 243

Chapter 12: Implementing VMware Server 245

Understanding VMware Server Architecture: Pros and Cons 246
Getting Your (Free) Copy of VMware Server 247
Acquiring VMware Server 248
Installing VMware Server 248
Creating a Guest Virtual Machine 252
Starting the VMware Server Console 252
Installing a new virtual machine 253
Installing an Operating System 258
Can I Skip the Boring OS Installation Process? 261
Can I Skip the Boring Application Installation Process? 263

Chapter 13: Implementing Fedora Virtualization 267

Obtaining Fedora 7 268
Installing Fedora 7 269
Creating a Guest Virtual Machine 278
Installing a Guest Operating System 286

Chapter 14: Implementing XenExpress 291

What Is XenSource, Anyway? 292
Obtaining XenSource XenExpress 292
Installing XenExpress 293
Installing XenConsole 296
Working with XenConsole 297

Creating a Guest Virtual Machine....300
Installing Paravirtualized Drivers....311
A bit of background, or QEMU who?....311
Baby, you can drive my virtualization environment....312
Accessing a Windows Guest VMwith an RDP Client....314

Part V: The Part of Tens....319

Chapter 15: Ten Steps to Your First Virtualization Project....321

Recite After Me: Virtualization Is a Journey, Not a Product....321
Evaluate Your Use Cases....322
Review Your Operations Organizational Structure....323
Define Your Virtualization Architecture....324
Select Your Virtualization Product(s)....325
Select Your Virtualization Hardware....325
Perform a Pilot Implementation....326
Implement Your Production Environment....326
Migrate Your Physical Servers....326
Manage Your Virtualized Infrastructure....327

Chapter 16: Ten Virtualization Pitfalls to Avoid....329

Don't Wait for All the Kinksto Be Worked Out....329
Don't Skimp on Training....330
Don't Apply Virtualization in AreasThat Are Not Appropriate....330
Don't Imagine That VirtualizationIs Static....331
Don't Skip the "Boring" Stuff....332
Don't Overlook a Business Case....332
Don't Overlook the Importanceof Organization....332
Don't Forget to Research Your Software Vendor Support Policies....333
Don't Overlook the Importanceof Hardware....333
Don't Forget to Have a Project Party....334

Chapter 17: Ten Great Resourceson Virtualization....335

Get Free Virtualization Software....336
Get Great Content about Virtualization....336
Get the Latest News about Virtualization....336
Read Blogs about Virtualization....337
Keep Up with Hardware Developments Relating to Virtualization....337
Find Out More about Virtualization....338
Attend Virtualization Events....338
Take Advantage of Vendor Information....339
Keep Up with Storage Virtualization....339
Get the Latest and Last Word on Virtualization....339

Index....341

Foreword

When Bernard invited me to write an introduction to this book, I found myself reminded of a frequently repeated conversation with my father, who is a retired engineer. Typically, it goes like this: "Simon, what does virtualization do?" — followed by a lengthy reply from me and then a long pause from my father — "And why is that useful?" Now, I certainly don't think that my father really has much use for server virtualization, but a lot more people do need it — and need to understand it — than currently use it.

Although virtualization is all the rage in the tech industry press, and savvy market watchers have observed the exciting IPO of VMware, and Citrix's acquisition of my own company, XenSource, the market for virtualization software is largely unaddressed. Depending on whose research you read, only 7 percent or so of x86 servers are virtualized, and only a tiny fraction of desktop or mobile PCs are virtualized. But the virtualization market is white hot, and every day new announcements in storage, server, and network virtualization make the picture more complex and harder to understand.

Virtualization For Dummies is the perfect way to develop a complete understanding of both the technology and the benefits of virtualization. Arguably, virtualization is simply a consequence of Moore's Law — the guideline developed by Intel founder Gordon Moore that predicts a doubling in the number of transistors per unit area on a CPU every couple of years. With PCs and servers becoming so incredibly powerful, the typical software suites that most users would install on a single physical server a few years ago now consume only a few percent of the resources of a modern machine. Virtualization is simply a consequence of the obvious waste of resources — allowing a machine to run multiple virtualized servers or client operating systems simultaneously. But if that were all that were needed, there wouldn't be such a fuss about virtualization. Instead, virtualization is having a profound impact on data center architectures and growth, on software lifecycle management, on security and manageability of software, and the agility of IT departments to meet with new challenges. And it is these opportunities and challenges that urgently need to be articulated to technologists and business leaders alike in an accessible and understandable way.

Having spent many enjoyable hours with Bernard Golden, a recognized open source guru, President and CEO of Navica, and self-taught virtualization expert, I cannot think of a better-qualified author for a book whose objective is to cut through the hype and clearly and succinctly deal with virtualization and its effects on IT and users alike. I always look forward to reading

Bernard's frequently published commentaries on Xen, VMware, and Linux, which combine his hands-on experience with those products and a rare depth of insight into industry dynamics. I know firsthand that Bernard is a master of the subject of virtualization because he is one of the most persistent and demanding beta testers of XenEnterprise, XenSource's server virtualization product, where his feedback has provided us with terrific guidance on how to improve the product overall. This, together with Bernard's incisive, clear, and articulate style, makes this book a pleasure to read and a terrific contribution to the virtualization industry — a concise categorization of virtualization that will further the understanding of the technology and its benefits, driving uptake of virtualization generally. It is with great pleasure that I strongly recommend that you read this book.

Simon Crosby

CTO, XenSource, Inc.

Introduction

If you work in tech, there's no way you haven't heard the term *virtualization.* Even if you don't work in tech, you might have been exposed to virtualization. In August 2007, virtualization's leading company, VMware, went public with the year's most highly anticipated IPO. Even people who confuse virtualization with visualization sit up and pay attention when a blockbuster IPO comes to market. To show how hot the sector is, VMware was bought by the storage company EMC for $625 million in 2004, but it has, as of this writing, a market capitalization of $25.6 *billion.*

The excitement and big dollars illustrate a fundamental reality about virtualization: It's transforming the way computing works. Virtualization is going to fundamentally change the way you implement and manage data centers, the way you obtain and install software, and the way you think about the speed with which you can respond to changing business conditions. The changes that virtualization will cause in your work environment will be so profound that, in ten years time, you'll look back on the traditional ways of managing hardware and software the way your grandparents looked back on operator-assisted telephone dialing after the introduction of direct dialing.

I wrote this book because I'm convinced that the world is on the cusp of an enormous change in the use of information technology, also known as IT. In the past, IT was expensive, so it was limited to must-have applications such as accounting and order tracking. In the past, IT was complex, so it had to be managed by a group of wizards with their own special language and incantations. That's all changing.

In the future, IT will be cheap, so applications will be ubiquitous, and low-priority applications will finally get their day in the sun. In the future, implementing IT will be simple, so groups outside of IT will shun the wizards' robes and arcane language and implement their own applications, which will, of course, make central IT's role even more important because it will have to create a robust yet malleable infrastructure.

Instead of IT being this special thing that supports only certain aspects of a business, it will become pervasive, suffusing throughout every business operation and every business interaction. It's an incredibly exciting time for IT; I compare it to the rise of mass production made possible by Henry Ford. Because of Henry Ford, automobiles went from playthings for the wealthy to everyday belongings of the masses, and society was transformed by mobility and speed. Virtualization is the mass production of IT.

Just as the automobile industry underwent rapid transformation after Ford invented mass production in 1913, the virtualization marketplace is transforming the IT industry today. One of the biggest challenges for this book is to present a coherent and unified view of the topic even though virtualization is evolving at an incredible pace. At times, I felt that writing this book was like trying to nail Jell-O to the wall. During just one week of the writing of this book, the IPO of VMware went from an event no one had even considered to the technology financial event of the year; in the same week, XenSource, the commercial sponsor of the open source Xen virtualization project, was purchased by Citrix for $500 million. Furthermore, myriads of virtualization technology and product announcements occurred, making me, at times, wish I could push a Pause button on the market so that I could have a hope of completing an up-to-date book. Alas, virtualization's fevered evolution shows no sign of diminishing — good for the virtualization user, challenging for the virtualization writer.

Why Buy This Book?

Even though virtualization is changing the face of technology, it is, unfortunately, still riddled with the complexities and — especially — the arcane language of tech. Two seconds into a conversation about virtualization, you'll start hearing terms like *hypervisor* and *bare metal,* which sound, respectively, like something from *Star Wars* and an auto shop class.

It's unfortunate that virtualization can be difficult to approach because of this specialized terminology. It's especially unfortunate because understanding and applying virtualization will be, in the near future, a fundamental skill for everyone in IT — and for many people working in other disciplines like marketing and finance. Consequently, having a strong grounding in virtualization is critical for people wanting to participate in the IT world of the future.

This book is designed to provide a thorough introduction to the subject. It assumes that you have no knowledge of virtualization and will leave you (I hope) with a good grasp of the topic. My objective is for you to be completely comfortable with virtualization and its many elements and to be able to participate and contribute to your organization's virtualization initiatives. The book also serves as a jumping-off point for deeper research and work in virtualization.

Foolish Assumptions

This book doesn't assume you know much about virtualization beyond having heard the term. You don't have to know any of the technical details of the topic, and you certainly don't need to have done hands-on work with

virtualization. (The book provides the opportunity to do hands-on work with virtualization, with three chapters devoted to installing and implementing different virtualization products.)

I define every virtualization term you encounter. I also make it a point to thoroughly explain complex topics so that you can understand the connections between different virtualization elements.

The book *does* assume that you have a basic understanding of computers, operating systems, and applications and how they work together to enable computers to do useful work. Because virtualization shuffles the placement and interaction of existing system software and hardware layers, it's important to have a grasp of how things are traditionally done. However, if you've worked with computers, used an operating system, and installed applications, you should have the knowledge base to make use of the book's content.

How This Book Is Organized

As is the case with other *For Dummies* books, this book doesn't assume that you'll begin on page one and read straight through to the end. Each chapter is written to stand alone, with enough contextual information provided so that you can understand the chapter's content. Cross-references are provided to other chapters that go into more detail about topics lightly touched on in a given chapter.

You'll soon notice, though, that individual chapters are grouped together in a somewhat-less-than-random order. The organizing principle here is the *part,* and this book has five of them.

Part 1: Getting Started with a Virtualization Project

Getting a good grounding in a subject is critical to understanding it and, more important, to recognizing how you can best take advantage of it. Part I provides a whirlwind tour of the world of virtualization — from where it is today to beyond where it will be tomorrow.

Chapter 1 is where you get an overview of virtualization, including an introduction to why it's such a hot topic. Chapter 1 also discusses the basic philosophy of virtualization — the abstraction of computer functionality from physical resources. Chapter 2 describes the business reasons that are driving virtualization's explosive growth, and it discusses how you can make a business case for your virtualization project. If you want a deeper understanding of the different technologies that make up virtualization as well as the different

ways virtualization is applied in everyday use, Chapter 3 is for you. Finally, if you want to get a sense of where virtualization is heading, Chapter 4 provides a glimpse of the exciting initiatives that are being made possible by virtualization.

Part II: Server Virtualization

Server virtualization is where the hottest action is in today's virtualization world. The most obvious use cases and the most immediate payoffs are available with server virtualization, and this part covers it all.

Chapter 5 gives you information for a litmus test to inform you whether server virtualization makes sense for you. The chapter lets you do a bit of self-testing to see whether your organization is ready to implement virtualization. Just as important, the chapter gives you the tools you'll need to find out whether it doesn't make sense for you to implement virtualization. Chapter 6 provides in-depth information on how to make a financial assessment of your virtualization project, including how to create a spreadsheet to calculate all the costs and benefits of a potential virtualization project. Chapter 7 discusses the all-important topic of how to manage a virtualization project; there's far more involved here than just installing a virtualization hypervisor. Finally, Chapter 8 discusses a very important topic — the hardware you'll use to run your virtualization software. There are many exciting developments in hardware with significant influence on the operational and financial benefits of virtualization.

Part III: Server Virtualization Software Options

Sometimes I see a movie with a happy ending and wonder "Yeah, but how did the rest of their lives turn out?" Virtualization can be something like that. If you listen to vendors, you just install their software and — presto! — instant virtualized infrastructure. Just like real life isn't like the movies, real infrastructure isn't like that, either, and Part III helps you have a true happy ending.

Chapter 9 deals with the critical issue of how to migrate an existing physical infrastructure to a virtualized one. (***Hint:*** It's more complex than the vendors claim.) Chapter 10 addresses managing a virtualized infrastructure; there are a plethora of options, and this chapter provides help in deciding which option is a good choice for you. Chapter 11 addresses a topic that's often an afterthought in virtualization: storage. For many organizations, virtualization provides the impetus to move to shared (also known as *virtualized*) storage. It's important to know what your storage options are and how to select one.

Part IV: Implementing Virtualization

If you're like me, theoretical understanding goes just so far. Then I want to roll up my sleeves and get my hands dirty. If you're like that as well, rejoice! Part IV can feed your hands-on hunger. In this part, I present three different examples of how to install and use virtualization. Best of all, each of the products used for the examples is available at no cost, making it possible for you to work along with them with no financial commitment.

Chapter 12 illustrates how to implement VMware Server as well as how to install a guest virtual machine. Chapter 13 works through Xen virtualization via the open source Linux distribution Fedora. Chapter 14 also illustrates a Xen-based virtualization, but the chapter uses the free XenExpress product from XenSource to share a different way of applying Xen virtualization.

Part V: The Part of Tens

Every *For Dummies* book concludes with a few chapters that provide a final burst of valuable information delivered in a sleek, stripped-down format — the time-honored ten-point list.

In Chapter 15, you get a list of the ten must-do steps for your first virtualization project. Chapter 16 shares ten no-no's to avoid in a virtualization project. And Chapter 17 gives you ten great virtualization resources for you to use after you finish this book.

Icons Used in This Book

This icon flags useful, helpful tips, or shortcuts.

This icon marks something that might be good to store away for future reference.

Pay attention. The bother you save might be your own.

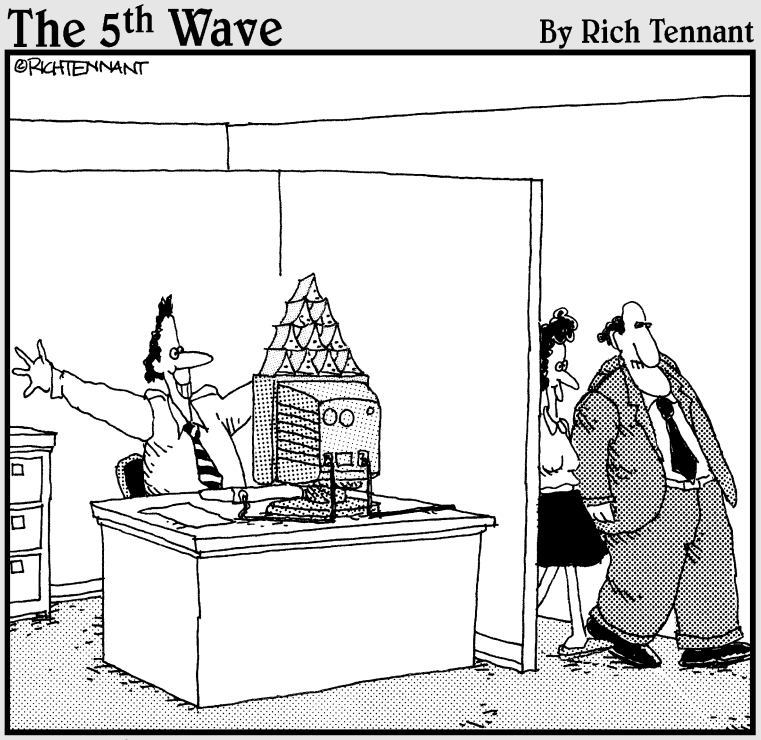
This icon highlights tidbits for the more technically inclined that I hope augment their understanding — but I won't be offended if less-technically inclined readers hurry through with eyes averted.

Where to Go from Here

Pick a page and start reading! You can use the Table of Contents as a guide, or my parts description in this introduction, or you can leaf through the index for a particular topic. If you're an accounting type, you might jump right into Chapter 6 — the chapter with all the lovely spreadsheets. If you're a hardcore techie type, you might want to check out Chapter 8 — yes, yes, the hardware chapter. Wherever you start, you'll soon find yourself immersed in one of the more exciting stories to come down the tech pipe in a long time.

Part I

Getting Started with a Virtualization Project



"Why, of course. I'd be very interested in seeing this new milestone in our server virtualization project."

In this part . . .

Virtualization is a hot topic. But what if you don't know enough to even fake it around the water cooler? Not to worry. This part gives even the virtualization-challenged a thorough introduction to the subject of virtualization.

It begins with an overview of virtualization — what it is and what all the different types of virtualization are. You didn't know there are different types? Well, this part is perfect for you.

For good measure, this part also includes an in-depth look at the technologies and applications of virtualization so that you can form an opinion of how it might be usefully applied to your own environment.

I conclude this part with a look at the future of virtualization. The area is evolving rapidly, and looking forward to future developments is exciting and, perhaps, sobering. Certainly I expect that virtualization will transform the way hardware and software is sold, so a peek into the future is well worth your time.

Chapter 1

Wrapping Your Head around Virtualization

In This Chapter

- Finding out what virtualization is
- Figuring out what has everyone so excited
- Seeing how virtualization is applied
- Working through the challenges of virtualization

It seems like everywhere you go these days, someone is talking about virtualization. Technical magazines trumpet the technology on their covers. Virtualization sessions are featured prominently at technology conferences. And, predictably enough, technology vendors are describing how *their* product is the latest word in virtualization.

If you have the feeling that everyone else in the world understands virtualization perfectly while you're still trying to understand just what it is and how you might take advantage of it, take heart. Virtualization *is* a new technology. (Actually, it's a pretty well-established technology, but a confluence of conditions happening just now has brought it into new prominence — more on that later in this chapter.) Virtualization *is* a technology being widely applied today with excellent operational and financial results, but it's by no means universally used or understood. That's the purpose of this book: to provide you with an introduction to the subject so that you can understand its promise and perils and create an action plan to decide whether virtualization is right for you, as well as move forward with implementing it should you decide it *is* right for you.

Sadly, not even this book can protect you from the overblown claims of vendors; there is no vaccine strong enough for that disease. This book helps you sort out the hope from the hype and gives you tools to feel confident in making your virtualization decisions.

Virtualization: A Definition

Virtualization refers to a concept in which access to a single underlying piece of hardware, like a server, is coordinated so that multiple guest operating systems can share that single piece of hardware, with no guest operating system being aware that it is actually sharing anything at all. (A *guest operating system* is an operating system that's hosted by the underlying virtualization software layer, which is often, you guessed it, called the *host system.*) A guest operating system appears to the applications running on it as a complete operating system (OS), and the guest OS itself is completely unaware that it's running on top of a layer of virtualization software rather than directly on the physical hardware.

Actually, you've had experience with something like this when you used a computer. When you interact with a particular application, the operating system "virtualizes" access to the underlying hardware so that only the application you're using has access to it — only your program is able to manipulate the files it accesses, write to the screen, and so on. Although this description oversimplifies the reality of how operating systems work, it captures a central reality: The operating system takes care of controlling how applications access the hardware so that each application can do its work without worrying about the state of the hardware. The operating system *encapsulates* the hardware, allowing multiple applications to use it.

In *server* virtualization — the most common type of virtualization — you can think of virtualization as inserting another layer of encapsulation so that multiple operating systems can operate on a single piece of hardware. In this scenario, each operating system believes it has sole control of the underlying hardware, but in reality, the virtualization software controls access to it in such a way that a number of operating systems can work without colliding with one another. The genius of virtualization is that it provides new capability without imposing the need for significant product or process change.

Actually, that last statement is a bit overbroad. A type of virtualization called paravirtualization does require some modification to the software that uses it. However, the resulting excellent performance can make up for the fact that it's a little less convenient to use. Get used to this exception business; the subject of virtualization is riddled with general truths that have specific exceptions. Although you have to take account of those exceptions in your particular project plans, don't let these exceptions deter you from the overarching circumstances. The big picture is what you need to focus on to understand how virtualization can help *you.*

Virtualization is actually a simple concept made complex by all the exceptions that arise in particular circumstances. It can be frustrating to find yourself stymied by what seems to be a niggling detail, but unfortunately, that's the reality of virtualization. If you stop to think about it, the complexity makes sense — you're moving multiple operating systems and applications onto a