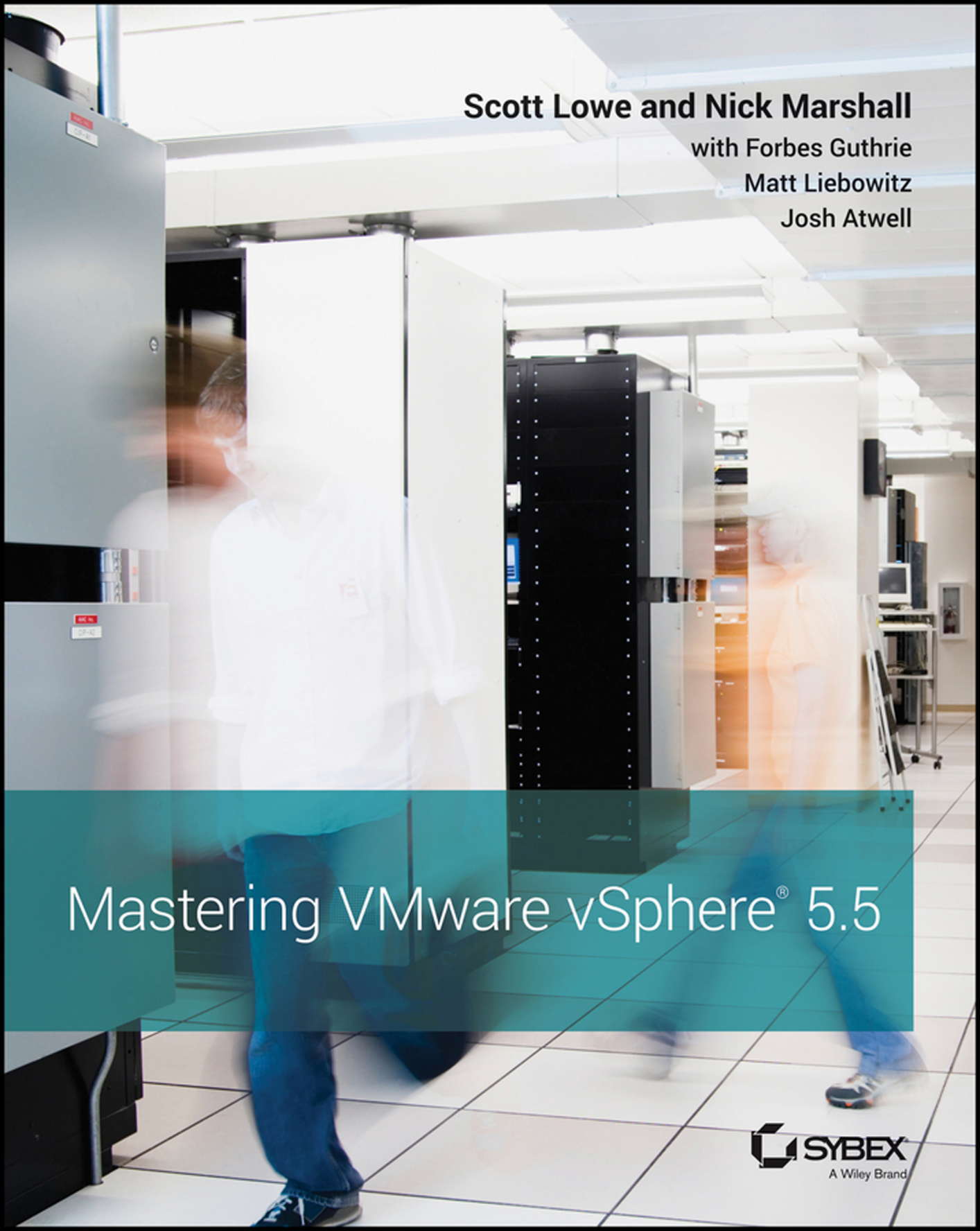




Scott Lowe and Nick Marshall

with Forbes Guthrie

Matt Liebowitz

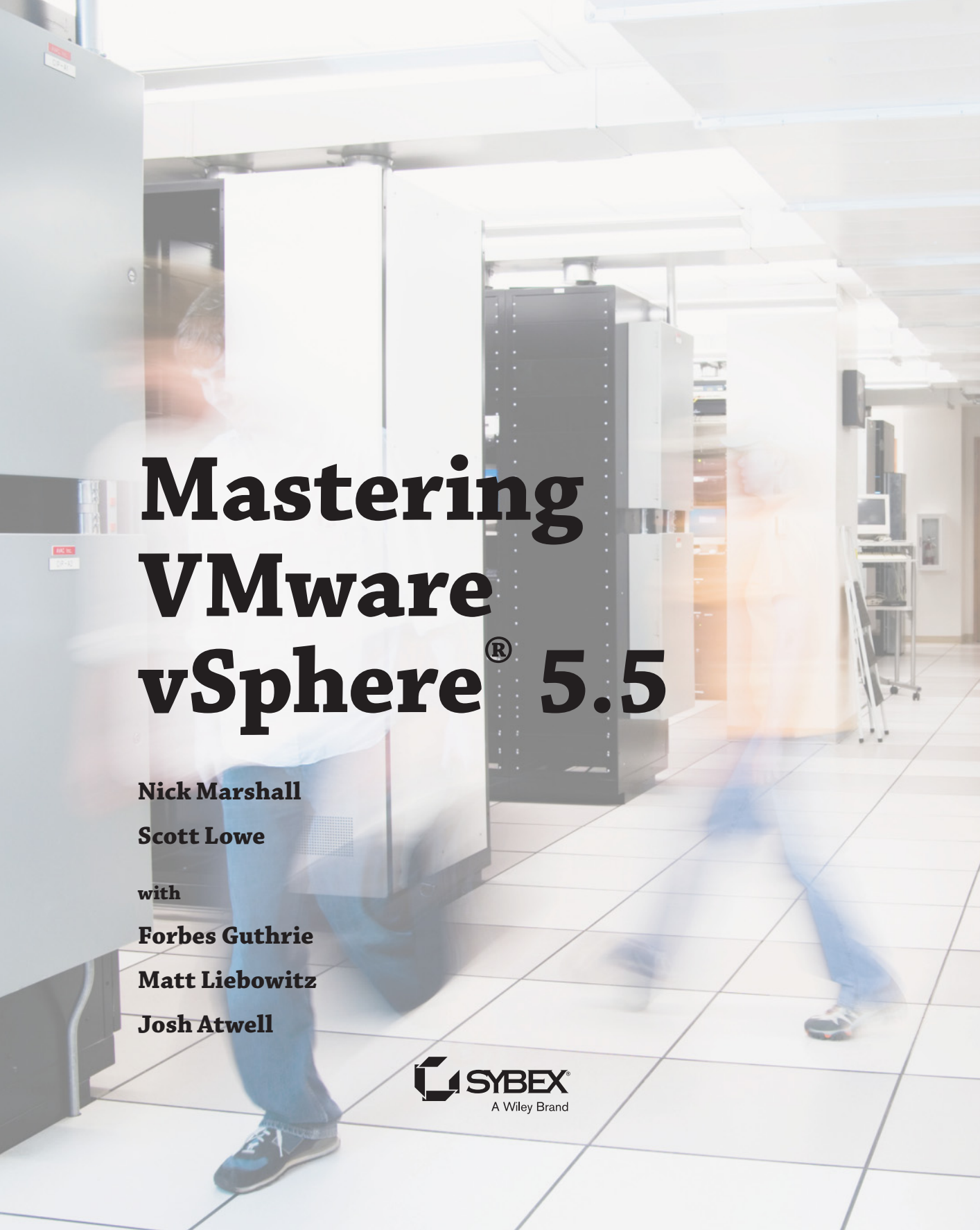
Josh Atwell

Mastering VMware vSphere® 5.5

 **SYBEX**
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A blurred background image of a server room. In the foreground, a person in a white shirt and blue jeans is walking from left to right. In the background, another person in an orange shirt and blue jeans is walking from right to left. The room is filled with rows of server racks and has a tiled floor.

Mastering VMware vSphere® 5.5



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Nick Marshall

Scott Lowe

with

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 **SYBEX®**
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Best regards,

A handwritten signature in black ink, appearing to read "Chris Webb". The signature is fluid and cursive, with the first name "Chris" and last name "Webb" clearly distinguishable.

Chris Webb
Associate Publisher
Sybex, an Imprint of Wiley

I dedicate this book to my wife, Natalie. Your support and encouragement is unwavering. I couldn't have completed such a task without you. I also dedicate this book to my mother. Mum, you were taken too soon but you still influence me every day.

—Nick Marshall

This book is dedicated to my Heavenly Father, who gives me lots of good and perfect gifts (James 1:17 NIV). The opportunity to write another book is one of those gifts, but more precious than that is the gift of family: my wife and my truest friend, Crystal; my kids (Summer, Johnny, Mike, Liz, Rhys, Sean, and Cameron); and those who have been brought into my family (Matt, Christopher, and Tim).

—Scott Lowe

Acknowledgments

When Scott Lowe expressed his interest to “collaborate on a writing project,” I would never have believed the journey that was to follow. It’s been a rollercoaster, but one I have thoroughly enjoyed. While writing a book has been a huge learning curve for me, one thing is certainly clear: You can’t underestimate how important those around you really are.

First of all I want to say thank you to Scott. Handing me such a great responsibility is an honor I will never forget. Your generosity is continuously evident to this day, and your reputation in the industry is second to none. Your work in Chapters 1 and 5 are top notch (as usual), and I hope we can work together again in the future.

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Finally, I would like to thank VMware—not only does this company provide me employment, but without VMware this book and more importantly this industry, would not be what it is today.

—Nick Marshall

There are some things that get easier after you’ve done them multiple times. Acknowledging all the people whose support makes writing a book possible isn’t one of those things.

I’ll start by thanking Nick Marshall, my partner in crime for this book and the bearer of the torch for future revisions of *Mastering VMware vSphere*. I’m thrilled to have had the opportunity to work with you, and I’m equally thrilled to know that this book series is as much a labor of love for you as it has been for me. I look forward to seeing future editions.

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As with any technical book, technical accuracy is critical. My thanks go to Jason Boche, who served as the technical editor for this edition. Jason, your oversight helped make sure that we all got the details correct. Thanks for your feedback, corrections, and constructive criticism.

Next, my thanks go to the entire Sybex team: Mariann Barsolo, the acquisitions editor; Stephanie Barton, the developmental editor; Dassi Zeidel, the production editor; Judy Flynn, the copyeditor; Rebecca Rider, the proofreader; Pete Gaughan, the editorial manager; and Neil Edde for his support. I don't know how the book publishing process works with other publishers, but I can say that you guys have made the process as painless as something like this can be. Thanks for everything.

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—*Scott Lowe*

About the Authors

Nick Marshall is a consultant with over 13 years IT experience and holds multiple advanced IT certifications, including VMware Certified Advanced Professional 5—Datacenter Administrator (VCAP5-DCA), and VMware Certified Advanced Professional 5—Datacenter Design (VCAP5-DCD). Currently working for VMware, he delivers virtualization and cloud solutions to some of the biggest organizations in the Asia-Pacific region.

Previously, Nick has worked in a number of roles ranging from computer assembler to infrastructure architect and has gained experience across the board. Nick is particularly proud of his ability to solve business problems with technical solutions.

Outside of his day job, Nick continues to work on his passion for virtualization by helping run the most popular virtualization podcast, *vBrownBag*, and writing on his personal blog, at www.nickmarshall.com.au. You can also find him speaking at industry conferences such as VMUG and PEX. To recognize his contributions to the VMware community, Nick has been awarded the vExpert award for both 2012 and 2013.

Nick lives with his wife, Natalie and son, Ethan in Sydney, Australia.

Scott Lowe is an author, consultant, speaker, and blogger focusing on virtualization, networking, storage, and other enterprise technologies. Scott is currently a technical architect at VMware, focused on software-defined networking (SDN) and network virtualization.

Scott's technical expertise extends into several areas. He holds industry certifications from Cisco, EMC, Microsoft, NetApp, VMware, and others. He also holds the premier VMware Certified Design Expert (VCDX) certification; Scott is VCDX #39. For Scott's leadership in, support of, and involvement with the VMware community, he has been awarded the vExpert designation for all five years since the program's inception (2009, 2010, 2011, 2012, and 2013).

As an author, Scott has contributed to numerous online magazines focused around VMware and related virtualization technologies. He is regularly quoted as a virtualization expert in virtualization news stories. He has five other published books: *Mastering VMware vSphere 4*; *VMware vSphere 4 Administration Instant Reference* (with Jase McCarty and Matthew Johnson); *VMware vSphere Design* (with Forbes Guthrie and Maish Saidel-Keesing); and *Mastering VMware vSphere 5* and *VMware vSphere Design, 2nd Edition* (both with Forbes Guthrie), all published by Sybex.

As a speaker, Scott has spoken at several virtualization conferences as well as at VMworld every year since 2009. He regularly speaks at VMware user group meetings, locally in the United States as well as worldwide.

Scott is perhaps best known for his acclaimed virtualization blog at <http://blog.scottlowe.org>, where he regularly posts technical articles on a wide variety of topics. VMware, Microsoft, and other virtualization industry leaders regularly refer to content on his site, and it is regularly voted among the top five virtualization weblogs worldwide. Scott's weblog is one of the oldest virtualization-centric weblogs that is still active; he's been blogging since early 2005.

Scott lives near Denver, Colorado, with his wife, Crystal; his two youngest sons, Sean and Cameron; and—during the school year—his Chinese exchange student, Tim.

About the Contributors

The following individuals also contributed to this book.

Forbes Guthrie (Chapter 4) is an infrastructure architect who specializes in virtualization. He has worked in a variety of technical roles for over 15 years and achieved several industry certifications, including VMware's VMware Certified Professional—Datacenter Virtualization (VCP2/3/4/5-DV), VMware Certified Advanced Professional 5—Datacenter Administrator (VCAP5-DCA), and VMware Certified Advanced Professional 5—Datacenter Design (VCAP5-DCD). His experience spans many industries, and he has worked in Europe, Asia-Pacific, and North America. He holds a bachelor's degree in mathematics and business analysis and is a former captain in the British Army.

Forbes is the lead author of the first (vSphere 4) and second (vSphere 5) edition of the acclaimed book *VMware vSphere Design*, co-authored by Scott Lowe. He also contributed to Scott's book *Mastering VMware vSphere 5*. Forbes has spoken at VMware's own VMworld conference on the subject of design and vSphere 5.

Forbes's blog, www.vReference.com, is well regarded in the virtualization field and is aggregated on VMware's Planet V12n website. He is probably best known for his collection of free reference cards, long revered by those studying for their VMware qualifications. Forbes has been awarded the luminary designation of vExpert by VMware for his contribution to the virtualization community since its inception. His passion and knowledge have also been rewarded with the peer-reviewed top virtualization bloggers listing for the last five years.

Matt Liebowitz (Chapter 9) is an advisory solution architect with EMC Consulting with a focus on virtualizing business-critical applications. He has been a consultant and architect for over 12 years and has been working with VMware's enterprise virtualization products since 2002. Matt is an author of several books on virtualization, is a frequent contributor to the VMware Technology Network (VMTN), and has been an active blogger on virtualization since 2009.

Matt is honored to have been named a VMware vExpert each year since 2010 and also holds numerous industry certifications from both VMware and Microsoft. He maintains a virtualization focused blog at www.thelowercasew.com and is active on Twitter at @mattdliebowitz.

When Matt is not out virtualizing the world, he is happily spending time with his wife, Joann, and his two kids, Tyler and Kaitlyn.

Josh Atwell (Chapter 14) is a vArchitect for VCE focusing on VMware and automation solutions on Vblock. Over the last 10+ years he has worked very hard to allow little pieces of code to do his work for him through various automation tools, especially PowerCLI. Josh is highly active in the virtualization community where he has led multiple technology-based user groups such as CIPTUG, VMUG, and UCS Users Group.

Josh holds both the VMware Certified Advanced Professional 5—Datacenter Administrator (VCAP5-DCA), and VMware Certified Advanced Professional 5—Datacenter Design (VCAP5-DCD) certifications and enjoys working with others on preparing for their certification pursuits through the *vBrownBag* podcast. Never known for lacking an opinion, he blogs at vtesseract.com and talks shop on Twitter as @Josh_Atwell. When not helping folks with things that start with *v*, he enjoys spending time with his children and his supportive wife, who has made everything mentioned possible.

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Foreword

Most people out there have a “bucket list,” a list of things they hope to see, do, or accomplish at some point in their life. One of the items on my bucket list had always been writing a book. The desire to write a book first emerged in my early teen years and continued well into adulthood. No matter how hard I tried, though, it seemed as if this particular bucket list item wasn’t going to get checked off the list. I know this seems like an odd statement to make now, but bear with me as I share the story—a story not everyone knows—about how that all changed.

The story starts in 2008. I’d managed to gain some visibility in the VMware community through my live-blogging of VMworld 2007 and VMworld 2008, and it was in 2008 that I met Chad Sakac. Chad is now a senior vice president at EMC Corporation, but then he was the leader of a small team of folks who later became known as the vSpecialists. At the time, making a connection with Chad was simply making a connection with a fellow virtualization geek. We chatted, traded virtualization stories, talked technology for a while, and that was that. Or so I thought.

Fast-forward to early 2009 when, somewhat out of the blue, I received an email from Chad. He’d been approached to write a book on VMware’s upcoming vSphere 4.0 product release, the email stated, but he was unable to do it. Would I be interested in writing the book, he asked, saying he thought I’d be perfect for the task. Would I be interested? What a question to ask! Of course I was interested. So I responded in the affirmative, Chad connected me with his contacts at Wiley/Sybex, contracts were signed, and off I went. Later that year, at VMworld 2009, my first book, *Mastering VMware vSphere 4*, was released and quickly became one of the hottest titles in virtualization. (Chad contributed the chapter about storage in that book, in case you didn’t already know.)

The rest, you could say, is history. My second book, *VMware vSphere 4 Administration Instant Reference*, was co-written with Jase McCarty and Matthew Johnson and released later in 2009. The third book, *VMware vSphere Design*, was co-written with Forbes Guthrie and Maish Saidel-Keesing and published in early 2011. *Mastering VMware vSphere 5*, an update to the book that started it all, was released later in 2011. Forbes and I teamed up again for *VMware vSphere Design, 2nd Edition*, which was released in early 2013.

Naturally, Wiley/Sybex had me in the crosshairs when it came time to talk about revising the *Mastering VMware vSphere* series for the vSphere 5.5 release. As much as I’ve enjoyed writing this series, this time around my mind went back to early 2009, and I thought about the excitement I’d felt when I was unexpectedly presented with the opportunity I’d always wanted. Sure, I could write the revision, but how much better would it be if I could “pay it forward,” so to speak, and give someone else in the community the same opportunity I’d been given? The opportunity to write *Mastering VMware vSphere 4* had been generously dropped in my lap; why not do the same for someone else?

The book you’re holding right now represents that decision to pay it forward. With the release of *Mastering VMware vSphere 5.5*, I’m officially passing the torch to Nick Marshall. Nick was a great selection to carry the torch. He’d already demonstrated a commitment to the community through his work on the vBrownBag podcast series as well as through his efforts with Alastair Cooke on AutoLab. During the writing of this book, I’ve been impressed with Nick’s knowledge, dedication to quality, and attention to detail. I’m very excited about Nick taking over the series, and I hope you are as well. I further hope that the VMware community offers Nick

the same level of support, feedback, and encouragement along his journey as an author as I have received during my journey.

I'm confident that you'll find this book to be every bit as useful, informative, and valuable as previous versions in the series have been. Nick, along with myself and a team of rock star contributors including Forbes Guthrie, Matt Liebowitz, and Josh Atwell, have put forth every effort to make sure that we have comprehensively addressed the new features and functionality in vSphere 5.5. This includes major new features like VSAN and expanded support for networking protocols like LACP. There's too much to mention here, but rest assured that the entire team has worked really hard to make this the authoritative title that you—the community—needs.

vSphere 5.5 represents a new release for VMware, and *Mastering VMware vSphere 5.5* represents a new release for this series. I hope that you enjoy both.

—Scott Lowe
VCDX, vExpert

Introduction

Back in 2005 I was trying to convince my boss that we should use GSX Server on our shiny new DL385. To him, it was a hard sell. He didn't understand why on earth we should install two operating systems onto a server, "It'll just slow it down!" he exclaimed. So I went ahead and started experimenting with VMware software on my desktop computer. Luckily at the time I had a workstation capable of running such things.

The times have changed quite a bit since then, and now virtualization—especially server virtualization—is readily embraced in corporate datacenters worldwide. VMware has gone from a relatively small vendor to one of the corporate heavyweights, garnering a commanding share of the server virtualization market with its top-notch virtualization products. Even now, when other companies such as Microsoft and Citrix have jumped into the server virtualization space, it's still VMware that's almost synonymous with virtualization. For all intents and purposes, VMware invented the market.

If you're reading this, though, there's a chance you're just now starting to learn about virtualization. What is virtualization, and why is it important to you?

I define *virtualization* as *the abstraction of one computing resource from another computing resource*. Consider storage virtualization; in this case, you are abstracting servers (one computing resource) from the storage to which they are connected (another computing resource). This holds true for other forms of virtualization, too, like application virtualization (abstracting applications from the operating system). When most information technology professionals think of virtualization, they think of hardware (or server) virtualization: abstracting the operating system from the underlying hardware on which it runs and thus enabling multiple operating systems to run simultaneously on the same physical server. That is the technology on which VMware has built its market share.

Almost single-handedly, VMware's enterprise-grade virtualization solution has revolutionized how organizations manage their datacenters. Before VMware introduced its powerful virtualization solution, organizations bought a new server every time a new application needed to be provisioned. Over time, datacenters became filled with servers that were all using only a fraction of their overall capacity. Even though these servers were underutilized, organizations still had to pay to power them and to dissipate the heat they generated.

Now, using VMware's server virtualization products, organizations can run multiple operating systems and applications on their existing hardware, and new hardware is purchased only when capacity needs dictate. No longer must organizations purchase a new physical server whenever a new application needs to be deployed. By stacking workloads together using virtualization, organizations derive greater value from their hardware investments. They also reduce operational costs by reducing the number of physical servers and associated hardware in the

datacenter, in turn decreasing power usage and cooling needs in the datacenter. In some cases these operational cost savings can be quite significant.

But consolidation is only one benefit of virtualization; companies also realize greater workload mobility, increased uptime, streamlined disaster-recovery options, and a bevy of other benefits from adopting virtualization. And virtualization, specifically server virtualization, has created the foundation for a new way of approaching the computing model: cloud computing.

Cloud computing is built on the tenets of broad network access, resource pooling, rapid elasticity, on-demand self-service, and measured service. Virtualization, such as that provided by VMware's products, enables the IT industry to embrace this new operational model of more efficiently providing services to their customers, whether those customers are internal (their employees) or external (partners, end users, or consumers). That ability to efficiently provide services is the reason virtualization is important to you.

This book provides all the information you, as an information technology professional, need to design, deploy, configure, manage, and monitor a dynamic virtualized environment built on VMware's enterprise-class server virtualization product, vSphere 5.5.

What Is Covered in This Book

This book is written with a start-to-finish approach to installing, configuring, managing, and monitoring a virtual environment using the VMware vSphere 5.5 product suite. The book begins by introducing the vSphere product suite and all of its great features. After introducing all of the bells and whistles, the book details an installation of the product and then moves into configuration. This includes configuring vSphere's extensive networking and storage functionality. We wrap up the configuration discussion with chapters on high availability, redundancy, and resource utilization. After completing the installation and configuration, we move into virtual machine creation and management and then into monitoring and troubleshooting. You can read this book from cover to cover to gain an understanding of the vSphere product suite in preparation for a new virtual environment, or you can use it as a reference if you are an IT professional who has begun your virtualization and wants to complement your skills with real-world tips, tricks, and best practices as found in each chapter.

This book, geared toward the aspiring as well as the practicing virtualization professional, provides information to help implement, manage, maintain, and troubleshoot an enterprise virtualization scenario.

Here is a glance at what's in each chapter:

- ◆ **Chapter 1: Introducing VMware vSphere 5.5** We begin with a general overview of all the products that make up the vSphere 5.5 product suite. This chapter also covers vSphere licensing and provides some examples of benefits that an organization might see from adopting vSphere as its virtualization solution.
- ◆ **Chapter 2: Planning and Installing VMware ESXi** This chapter looks at selecting the physical hardware, choosing your version of VMware ESXi, planning your installation, and actually installing VMware ESXi, both manually and in an unattended fashion.
- ◆ **Chapter 3: Installing and Configuring vCenter Server** In this chapter, we dive deep into planning your vCenter Server environment. vCenter Server is a critical management

component of vSphere, and so this chapter discusses the proper design, planning, installation, and configuration for vCenter Server.

- ◆ **Chapter 4: vSphere Update Manager and the vCenter Support Tools** This chapter describes what is involved in planning, designing, installing and configuring the vSphere Update Manager. You'll use vCenter Update Manager to keep your vSphere environment patched and up-to-date.
- ◆ **Chapter 5: Creating and Configuring Virtual Networks** The virtual networking chapter covers the design, management, and optimization of virtual networks, including new features like the vSphere Distributed Switch and other third-party switches. In this chapter we also initiate discussions and provide solutions on how to integrate the virtual networking architecture with the physical network architecture while maintaining network security.
- ◆ **Chapter 6: Creating and Configuring Storage Devices** This in-depth chapter provides an extensive overview of the various storage architectures available for vSphere. In this chapter we discuss Fibre Channel, iSCSI, and NAS storage design and optimization techniques as well as storage features like thin provisioning, multipathing, and round-robin load balancing.
- ◆ **Chapter 7: Ensuring High Availability and Business Continuity** This exciting chapter covers the hot topics regarding business continuity and disaster recovery. We provide details on building highly available server clusters in virtual machines. In addition, this chapter discusses the use of vSphere High Availability (HA) and vSphere Fault Tolerance (FT) as ways of providing failover for virtual machines running in a vSphere environment. We also discuss backup options using vSphere's Storage APIs.
- ◆ **Chapter 8: Securing VMware vSphere** Security is an important part of any implementation, and in this chapter we cover different security management aspects, including managing direct ESXi host access and integrating vSphere with Active Directory. This chapter also covers how to manage user access for environments with multiple levels of system administration and how to employ Windows users and groups in conjunction with the vSphere security model to ease the administrative delegation that comes with enterprise-level deployments.
- ◆ **Chapter 9: Creating and Managing Virtual Machines** This chapter introduces the practices and procedures involved in provisioning virtual machines through vCenter Server. In addition, you're introduced to timesaving techniques, virtual machine optimization, and best practices that will ensure simplified management as the number of virtual machines grows larger over time.
- ◆ **Chapter 10: Using Templates and vApps** Chapter 10 introduces the idea of templates, a mechanism for more rapidly deploying standardized VM images. We also discuss cloning and the concept of a vApp—a specialized container used by vSphere for the distribution of multi-VM environments. In addition, we discuss the OVF standard used by VMware and other vendors for distributing VMs.
- ◆ **Chapter 11: Managing Resource Allocation** In this chapter we provide a comprehensive look at managing resource allocation. From individual virtual machines to resource pools

and clusters of ESXi hosts, this chapter explores how resources are consumed in vSphere and addresses the mechanisms you can use—reservations, limits, and shares—to manage and modify that resource allocation.

- ◆ **Chapter 12: Balancing Resource Utilization** Resource allocation isn't the same as resource utilization, and this chapter follows up the discussion of resource allocation in Chapter 11 with a look at some of the ways vSphere offers to balance resource utilization. In this chapter, you'll learn about vSphere vMotion, Enhanced vMotion Compatibility, vSphere Distributed Resource Scheduler (DRS), Storage vMotion, and Storage DRS.
- ◆ **Chapter 13: Monitoring VMware vSphere Performance** In Chapter 13 we look at some of the native tools in vSphere that give virtual infrastructure administrators the ability to track and troubleshoot performance issues. The chapter focuses on monitoring CPU, memory, disk, and network adapter performance across ESXi hosts, resource pools, and clusters in vCenter Server. In this chapter you'll also learn about vCenter Operations Manager.
- ◆ **Chapter 14: Automating VMware vSphere** Many tasks VMware vSphere administrators face are repetitive, and here automation can help. In Chapter 14 we discuss several different ways to bring automation to your vSphere environment, including vCenter Orchestrator and PowerCLI.
- ◆ **Appendix: The Bottom Line** This appendix offers solutions to the Master It problems at the end of each chapter.

The Mastering Series

The Mastering series from Sybex provides outstanding instruction for readers with intermediate and advanced skills, in the form of top-notch training and development for those already working in their field and clear, serious education for those aspiring to become pros. Every Mastering book includes the following:

- ◆ Real-World Scenarios, ranging from case studies to interviews, that show how the tool, technique, or knowledge presented is applied in actual practice
- ◆ Skill-based instruction, with chapters organized around real tasks rather than abstract concepts or subjects
- ◆ Self-review test questions, so you can be certain you're equipped to do the job right

The Hardware behind the Book

Starting out, it can seem difficult to build an environment in which you can learn by implementing the exercises and practices detailed in this book. It is possible to build a practice lab with minimal hardware, and we encourage you to follow along with the book. If you're just starting, we recommend building a nested virtual lab on your laptop or desktop computer. Head to www.labguides.com for details on AutoLab, a nested vSphere automation tool. It only needs VMware Workstation or Fusion installed and 8 GB of RAM. Be sure to read Chapter 2 and Chapter 3 before you attempt to construct any type of environment for development purposes.