

A man in a light-colored short-sleeved shirt stands in a server room, looking at a computer monitor on a stand. He is positioned in front of a long row of tall server racks. The room is brightly lit, and the floor is covered with a grid of perforated metal tiles. The background shows more server racks extending into the distance.

Brian Svidergol
Vladimir Meloski
Byron Wright
Santos Martinez
Doug Bassett

Mastering Windows Server® 2016

A man in a light-colored shirt and dark trousers stands in a server room, working at a mobile workstation on wheels. The workstation includes a monitor and a keyboard. He is positioned next to a long row of server racks. The room has a perforated floor and overhead lighting. The text "Mastering Windows Server® 2016" is overlaid on the image.

Mastering Windows Server® 2016

A black and white photograph of a man in a light-colored shirt and dark trousers standing in a server room. He is looking at a computer monitor on a stand, with his hand on the keyboard. The room is filled with tall server racks, and the floor is covered with a grid of perforated tiles. The lighting is bright, coming from the left side.

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I'd like to thank my wife, Lindsay; my son, Jack; and my daughter, Leah, for their continued support and for the joy they bring me regularly.

—Brian Svidergol

To my loving family who always supports me.

—Vladimir Meloski

I'd like to thank Tracey, Sammi, and Michelle for consistently being the best part of my day.

—Byron Wright

I want to dedicate this book to the following: my wife, Karla; you are my soulmate, and I want to grow old with you. To my kids, Bryan and Naomi, I hope this gives you some inspiration one day of what you can possibly achieve; and finally thank you to all my family and friends for their support in my craziness. Also to my martial arts students, peers, and masters, thank you for allowing me to be who I am as a professional and a martial arts master.

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—Santos Martinez

I dedicate this book to my grandmother, Helen Wells, who bought me my first computer, and to my grandfather, Lyle Wells, for not killing her.

—Doug Bassett

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Introduction

Welcome to *Mastering Windows Server 2016*. This book covers Windows Server 2016 and the core technologies built into the operating system. It has a mix of content ranging from networking, identity and access, storage, and much more. We don't cover every single feature or option but focus on providing a deep understanding of the key topics that we cover throughout the chapters. This book is best read from front to back and can later used as a reference.

Major Changes in Windows Server 2016

Most of the major components of Windows Server 2016 have new features, enhancements, and changes for Windows Server 2016. With that said, most of the changes involve improvements to existing services and the introduction of new features. Throughout the chapters, we will look at some of these new features in detail. The following major changes represent the changes that we feel stand out from the rest:

Nested Virtualization With nested virtualization, a brand new feature for Windows Server 2016, you can deploy a Hyper-V host inside of a VM. This simplifies the process for testing failover clustering and for testing a variety of virtualization-related features and configurations. Note that nested virtualization is best suited for nonproduction environments, such as a lab environment. See Chapter 3 for more information.

Shielded Virtual Machines This new feature enhances the security of Hyper-V hosts and VMs. It protects against scenarios such as malicious administrators trying to view the console or trying to view the data on the virtual hard disks. See Chapter 3 for more information.

Device Guard and Credential Guard These new features protect Generation 2 VMs against exploits. See Chapter 8 for more information.

Privileged Access Management (PAM) PAM enhances the security of Active Directory Domain Services environments by completely changing the way many administrators manage their environments. See Chapter 9 for more information.

Storage Spaces Direct This new feature provides a highly available and highly scalable storage solution using local server storage. See Chapter 4 for more information.

Software Defined Networking (SDN) There are many new enhancements to networking in Windows Server 2016. SDN enables you to configure your on-premises environment like Azure and manage it using System Center Virtual Machine Manager. See Chapter 5 for more information.

Containers Containers are a feature that offers a way for app teams to have a prepackaged way to deploy app environments quickly (for example, IIS with ASP.NET). The container contains everything an app team needs—and the container is portable; it can run on-premises or in the public cloud. See Chapter 7 for more details.

Nano Server When Microsoft introduced the Server Core installation of Windows Server, it was lauded for the small size, small requirements, high performance, and enhanced security. Nano Server went a step further (albeit with more limitations). Initially, it was just a smaller footprint deployment, without a GUI, that could run some core roles such as Hyper-V and Scale-Out File Server. However, recently Microsoft announced some big changes for Windows Server 2016 (release 1709). With 1709, Nano Server will no longer support the core roles such as Hyper-V. Instead, it will be dedicated for containers and be geared for the cloud. Nano Server is introduced in Chapter 1.

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:

- ◆ Skill-based instruction with chapters organized around real tasks rather than abstract concepts or subjects
- ◆ End of chapter “Master It” scenarios to test your knowledge of the information in the chapter

How to Use This Book

How you use this book will depend on your goals and your level of experience across the Windows Server technologies. For example, if you have limited experience with Windows Server, then reading the book from front to back might provide the best experience. If you are an experienced server administrator but want to learn more about the networking components of Windows Server 2016, then you might want to go straight to the networking-related chapters. If you are studying for a certification exam, you might want to read specific topics from various chapters to strengthen your knowledge in very specific areas. While the book is ordered so that it is easiest to read it front to back, take the path that best suits your experience and goals.

In several parts of the book, we will perform step-by-step installations and configurations. We highly recommend that you perform those same steps in your lab or nonproduction environment (whether at home or at work). Reading about a technology is good for learning. Deploying, troubleshooting, and maintaining a technology is good for learning. Doing both is great for learning!

Windows Server is a huge product. There is a plethora of technologies in it—and the technologies are complex, much more so than in previous versions (especially older and legacy versions) of Windows Server. Therefore, as authors, we must pick and choose exactly what we cover while still trying to keep the book manageable in size. In general, for this book, we have opted to cover the most used parts of Windows Server, and we try to go into detail in specific parts of

every chapter. Lastly, we avoid the introductory information unless it is imperative to the topic. Our readers have historically been experienced administrators who are looking to enhance their knowledge of the newest version of Windows Server. Therefore, we try to avoid material that is “too basic” for our typical reader.

How This Book Is Organized

Each *Mastering Windows Server 2016* chapter represents a milestone in your progress toward becoming an expert Windows Server 2016 user. We start off by walking you through the installation, Server Manager, and PowerShell. It is a good way to start and enables you to have a Windows Server 2016 computer to reference while working through the step-by-step sections of chapters. It is also good to know the tools that we are going to reference throughout the book (especially PowerShell) before we dive into them!

- ◆ Chapter 1, “Windows Server 2016 Installation and Management,” shows you how to install Windows Server 2016 and how to work with Server Manager for server administration.
- ◆ Chapter 2, “PowerShell,” details how to work with PowerShell. It covers a huge amount of information in a single chapter and will be especially beneficial to readers who aren’t well-versed in PowerShell yet.

After you have an installation and know your way around the management of Windows Server, you are ready to dive deeper into the foundational technologies.

- ◆ Chapter 3, “Compute,” is all about the compute portions of Windows Server, such as Hyper-V and failover clustering.
- ◆ Chapter 4, “Storage,” details file systems, data deduplication, Storage Spaces, Storage Replica, and Storage Quality of Service.
- ◆ Chapter 5, “Networking,” dives into remote access, DNS, DHCP, and a host of new networking technologies in Windows Server 2016.

At this point, you’ll have a pretty good grasp of the basics of Windows Server 2016 and understand some of the new technologies. The next chapters are designed to help you branch out into smaller (but still important) technologies in Windows Server.

- ◆ Chapter 6, “File Services,” tells you how to implement and manage file services—not just shared folders but the advanced aspects of managing file services.
- ◆ Chapter 7, “Windows Server Containers,” explains what containers are, how they work, and how to create and manage them. This technology is new and rapidly evolving.
- ◆ Chapter 8, “Security Mechanisms,” is where you’ll learn about Just Enough Administration (JEA), Just In Time (JIT) administration, Credential Guard, and other new security features in Windows Server 2016.

Several Active Directory technologies are built into Windows Server 2016. In this book, we cover the three most deployed. We exclude AD LDS and AD RMS.

- ◆ Chapter 9, “Active Directory Domain Services,” covers AD DS, including information about design and architecture, deployment, and day-to-day administration.
- ◆ Chapter 10, “Active Directory Certificate Services,” covers AD CS and public key infrastructure technologies. It also walks through a step-by-step two-tier hierarchy.
- ◆ Chapter 11, “Active Directory Federation Services,” takes you through AD FS and design considerations. Then, it walks you through a step-by-step implementation of AD FS and Web Application Proxy.

Earlier in the book, we cover managing servers one at a time with Server Manager and PowerShell. In this part of the book, we look at managing servers at the enterprise level where automation and self-service are keys to successful management.

- ◆ Chapter 12, “Management with System Center,” introduces you to the entire suite of Microsoft System Center. It walks through deployment and configuration, as well as introduces the concepts around enterprise management.
- ◆ Chapter 13, “Management with OMS,” shows you how to use Microsoft Operations Management Suite (OMS), an Azure service, to manage your on-premises and cloud-based Windows servers.

Getting More Information

In each chapter, you will see links to external sources for additional information. Whenever you have an interest in a particular topic and we link to an external resource, you should opt to spend a few minutes exploring that content. We specifically tried to link to value-adding material that complements and sometimes expands upon the information in the book.

Errata

We hope that *Mastering Windows Server 2016* will be of benefit to you and that, after you’ve read the book, you’ll continue to use the book as a reference. Please note that while we have made every effort toward accuracy, sometimes software updates will cause a screenshot to look slightly different than the interface you see on your screen. You should still be able to follow along with the instructions given. However, if you find errors, please let our publisher know by emailing to errata@wiley.com.

Thanks for choosing *Mastering Windows Server 2016*!



Chapter 1

Windows Server 2016 Installation and Management

Windows Server 2016 builds on the installation and management processes of earlier Windows Server versions. To install Windows Server 2016, you need to understand the editions of Windows Server 2016 and how they are licensed. This will enable you to select the edition of Windows Server 2016 that best meets your needs. You also need to select an appropriate installation method such as automation with Windows Deployment Services.

After installing Windows Server 2016, Server Manager is the main interface that you'll use for management. From Server Manager, you can launch tools that you can use to manage and monitor Windows Server 2016.

IN THIS CHAPTER, YOU WILL LEARN TO:

- ◆ Define a deployment process
- ◆ Select an edition of Windows Server 2016
- ◆ Select an activation method
- ◆ Monitor Windows Server 2016

Windows Server 2016 Editions and Licensing

Microsoft has had various editions of Windows Server with each generation. Depending on the generation of Windows Server, varying editions came with different features or different licensing. You can obtain Windows Server 2016 Standard or Windows Server 2016 Datacenter. The vast majority of features are the same between the two editions, but there are some significant differences worth noting and they are listed in Table 1.1.

TABLE 1.1: Windows Server 2016 Edition Differences

FEATURE	DESCRIPTION
Virtualization Licensing	One Windows Server 2016 Standard license can be used for two virtual machines on a single virtualization host.
	One Windows Server 2016 Datacenter license can be used for an unlimited number of virtual machines on a single virtualization host.

TABLE 1.1: Windows Server 2016 Edition Differences (CONTINUED)

FEATURE	DESCRIPTION
Software Defined Networking	This feature that applies policies to control network configuration and security is not included in Standard edition.
Shielded Virtual Machines	To configure Shielded virtual machines, the Hyper-V host must be running Windows Server 2016 Datacenter edition.
Hyper-V Containers	Windows Server 2016 Standard has a limit of two Hyper-V Containers per Hyper-V host. Windows Server 2016 can have an unlimited number of Hyper-V Containers. Both editions of Windows Server 2016 can have an unlimited number of standard containers.
Storage Replica	This feature that synchronizes data between two servers is available only in Windows Server 2016 Datacenter edition.
Storage Spaces Direct	This feature that provides high availability for file shares is available only in Windows Server 2016 Datacenter edition.

As you can see from Table 1.1, there are only a few feature differences between Windows Server 2016 Standard and Windows Server 2016 Datacenter. If those features are not required, then the primary driver for selecting an edition of Windows Server 2016 is usually virtualization licensing.

Most organizations deploy new servers as virtual machines. With a single Windows Server 2016 Standard license, you can install Windows Server 2016 Standard with Hyper-V for a virtualization host and configure two virtual machines with Windows Server 2016 Standard. By purchasing a second Windows Server 2016 Standard license, you can add two more virtual machines running Windows Server 2016 Standard. In smaller organizations with only a few virtual machines per virtualization host, it is often cost-effective to use Windows Server 2016 Standard.

In larger organizations with many virtual machines, it is often more cost-effective and easier to manage if you use Windows Server 2016 Datacenter. With a single Windows Server 2016 Datacenter license, you can install Windows Server 2016 Datacenter with Hyper-V for a virtualization host and configure an unlimited number of virtual machines on that host.

VIRTUALIZATION LICENSING WITHOUT HYPER-V

Hyper-V is an excellent hypervisor that is widely used to implement server and desktop virtualization. However, there are other hypervisors such as VMware, XenServer, and others. When you use a hypervisor other than Hyper-V, the licensing for the virtual servers works exactly the same as if you were using Hyper-V. A Windows Server 2016 Standard license allows you to implement two virtual machines running Windows Server 2016 Standard on any hypervisor. A Windows Server 2016 Datacenter license allows you to implement an unlimited number of virtual machines running Windows Server 2016 Datacenter on any hypervisor.