NETWORKING

MCSA Guide to Installing and Configuring Microsoft® Windows Server® 2012/R2

Exam 70-410

MCSE
MCSA

Greg Tomsho

Microsoft Certification Exam Objectives
Exam #70-410: Installing and Configuring Microsoft Windows Server 2012

Objective	Chapters
Install and configure servers	
Install servers	2
Configure servers	3
Configure local storage	4
Configure server roles and features	
Configure file and share access	5
Configure print and document services	5
Configure servers for remote management	3
Configure Hyper-V	
Create and configure virtual machine settings	12
Create and configure virtual machine storage	12
Create and configure virtual networks	12
Deploy and configure core network services	
Configure IPv4 and IPv6 addressing	9
Deploy and configure Dynamic Host Configuration Protocol (DHCP) service	11
Deploy and configure DNS service	10
Install and administer Active Directory	
Install domain controllers	6
Create and manage Active Directory users and computers	7
Create and manage Active Directory groups and organizational units (OUs)	7
Create and manage Group Policy	
Create Group Policy objects (GPOs)	6, 8
Configure security policies	8
Configure application restriction policies	8
Configure Windows Firewall	8

MCSA Guide to
Installing and Configuring Microsoft® Windows Server® 2012/R2, Exam 70-410

Greg Tomsho

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MCSA Guide to Installing and Configuring Microsoft® Windows Server® 2012/R2, Exam 70-410
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Brief Contents

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Introduction

MCSA Guide to Installing and Configuring Microsoft® Windows Server® 2012/R2, Exam 70-410, gives you in-depth coverage of the 70-410 certification exam objectives and focuses on the skills you need to install and configure Windows Server 2012/R2. With more than 130 hands-on activities and dozens of skill-reinforcing case projects, you'll be well prepared for the certification exam and learn valuable skills to perform on the job.

After you finish this book, you'll have an in-depth knowledge of Windows Server 2012/R2, including installation, local and remote management, file and storage services, Active Directory, group policies, TCP/IP, networking services, and Hyper-V virtualization. Both the original release of Windows Server 2012 and the R2 release are covered.

Intended Audience

MCSA Guide to Installing and Configuring Microsoft® Windows Server® 2012/R2, Exam 70-410, is intended for people who want to learn how to configure and manage a Windows Server 2012/R2 network and earn the Microsoft Certified Solutions Associate (MCSA) certification. This book covers in full the objectives of the first exam (70-410) needed to be MCSA: Windows Server 2012 certified. This book serves as an excellent tool for classroom teaching, but self-paced learners will also find that the clear explanations and challenging activities and case projects serve them equally well. Although this book doesn't assume previous experience with Windows servers, it does assume a familiarity with current Windows OSs, such as Windows 7 or Windows 8.x. Networking knowledge equivalent to an introductory networking course or Network+ is highly recommended.

What This Book Includes

- A Windows Server 2012 R2 Datacenter Edition evaluation DVD is bundled with the book. It can be installed on a physical computer or in a virtual machine, using Microsoft Hyper-V, VMware Workstation, VMware Player, VirtualBox, or another compatible virtualization program.
- A lab setup guide is included in the "Before You Begin" section of this introduction to help you configure a physical or virtual (recommended) lab environment for doing the hands-on activities.

- Step-by-step hands-on activities walk you through tasks ranging from a basic Windows Server 2012 R2 installation to complex multiserver network configurations involving Active Directory, Group Policy, DNS, and many other services. All activities have been tested by a technical editor, reviewers, and validation experts.
- Extensive review and end-of-chapter materials reinforce your learning.
- Challenging case projects require you to apply the concepts and technologies learned throughout the book.
- Abundant screen captures and diagrams visually reinforce the text and hands-on activities.
- A list of 70-410 exam objectives is cross-referenced with chapters and sections that cover each objective.

About Microsoft Certification: MCSA/MCSE

This book prepares you to take the first exam in the Microsoft Certified Solutions Associate (MCSA) Windows Server 2012 certification. The MCSA Windows Server 2012 certification is made up of three exams, which should be taken in order as follows:

- Exam 70-410: Installing and Configuring Windows Server 2012
- Exam 70-411: Administering Windows Server 2012
- Exam 70-412: Configuring Advanced Windows Server 2012 Services

Taking the exams in order is important because the objectives build on one another, with some topics introduced in an earlier exam and reinforced in subsequent exams.

Microsoft Certified Solutions Expert (MCSE): The Next Step

After achieving the MCSA Windows Server 2012 certification, you can move on to the MCSE certification. Microsoft offers three main options, and all require the three MCSA exams as a prerequisite:

- MCSE: Server Infrastructure
  - Exam 70-413: Designing and Implementing a Server Infrastructure
  - Exam 70-414: Implementing an Advanced Server Infrastructure
- MCSE: Desktop Infrastructure
  - Exam 70-415: Implementing a Desktop Infrastructure
  - Exam 70-416: Implementing Desktop Application Environments
- MCSE: Private Cloud
  - Exam 70-246: Monitoring and Operating a Private Cloud with System Center 2012
  - Exam 70-247: Configuring and Deploying a Private Cloud with System Center 2012

Chapter Descriptions

This book is organized to familiarize you with Windows Server 2012/R2 features and technologies and then provide in-depth coverage of Windows services. It wraps up by discussing Hyper-V virtualization, a technology that's the cornerstone of Microsoft's private cloud initiatives. The 70-410 exam objectives are covered throughout the book, and you can find a mapping of objectives and the chapters in which they're covered on the inside front cover, with a more detailed mapping in Appendix A. The following list describes this book's chapters:

- **Chapter 1**, "Introducing Windows Server 2012/R2," describes the role of a server operating system and compares the Windows Server 2012/R2 editions. Next, you're given an overview of Windows Server 2012/R2 core technologies, such as the NTFS file system, Active Directory, disk management, and networking. Finally, you learn about server roles and new features in Windows Server 2012/R2.
- **Chapter 2**, "Installing Windows Server 2012/R2," discusses the details of planning a Windows Server 2012/R2 installation, including installing the first server on a new network, expanding an existing network, and upgrading to Windows Server 2012/R2,

including server role migration. The Server Core installation option is discussed next, followed by optimizing an installation by using Features on Demand.

- **Chapter 3**, "Local and Remote Server Management," explains how to work with server roles and features and how to configure server modes. Next, you learn how to manage servers remotely with new features in Server Manager. This chapter wraps up with a discussion on configuring services and NIC teaming and working with downlevel servers.
- **Chapter 4**, "Configuring Server Storage," describes the methods available for storage provisioning, including working with local and virtual disks and using disk partition and format options. You learn about the types of volumes you can create on a Windows server and how to use Storage Spaces, a new feature in Windows Server 2012/R2.
- **Chapter 5**, "File and Printer Services," discusses how Windows implements file and printer sharing. You learn how to secure access to files by using NTFS permissions and how permission inheritance works. This chapter also explains default and administrative shares and managing shared folders. Work Folders, a new feature in Windows Server 2012/R2, is discussed next, followed by details on configuring and managing Windows printing.
- **Chapter 6**, "Introducing Active Directory," describes the role of a directory service in a network and explains how to install Active Directory. Next, you learn about Active Directory components, such as the schema and Active Directory objects, and the Active Directory structure, including forests, trees, and domains. This chapter ends with an introduction to Group Policy.
- **Chapter 7**, "Managing OUs and Active Directory Accounts," gives you an in-depth look at the core organizing object in Active Directory: organizational units. Active Directory object permissions and delegation of control are discussed in detail. Next, you learn how to manage user accounts, group accounts, and computer accounts. Finally, you see how to use command-line tools to automate account management.
- **Chapter 8**, "Configuring Group Policies," gives you a detailed look at the architecture of Group Policy and Group Policy objects (GPOs). You learn how group policy replication works and how to create and link GPOs. You also learn about group policy inheritance and precedence, including local GPOs. Group policy nodes and some of their many settings are described, with particular attention to security settings and using security templates.
- **Chapter 9**, "Configuring TCP/IP," describes the TCP/IP protocol and its components. You learn how to configure TCP/IP addresses and calculate subnet masks for IPv4 addresses. Then you learn about IPv6 addresses and how to configure IPv6 autoconfiguration. Finally, you learn about IPv4-to-IPv6 transition technologies.
- **Chapter 10**, "Configuring DNS," gives you an overview of the Domain Name System and explains how to install DNS and create DNS zones. You learn about configuring zones, including Active Directory–integrated zones, zone replication, forward and reverse lookup zones, dynamic updates, and zone transfers. Finally, you explore advanced DNS server settings, such as forwarders and root hints, and see how to monitor and troubleshoot DNS.
- **Chapter 11**, "Configuring Dynamic Host Configuration Protocol," describes the DHCP protocol and the client address leasing process. You learn about installing and configuring a DHCP server, which includes scope configuration, DHCP reservations, and filters. This chapter ends with a discussion of DHCP server settings and how to configure a DHCP relay agent.
- **Chapter 12**, "Configuring Virtualization with Hyper-V," describes the Hyper-V server role installation and configuration. You learn how to create and configure virtual machines and virtual networks, including external, internal, and private virtual switches. You also learn about features such as checkpoints, dynamic memory, and types of virtual disks.
- **Appendix A**, "MCSA 70-410 Exam Objectives," maps each 70-410 exam objective to the chapter and section where you can find information on that objective.

Features

This book includes the following learning features to help you master the topics in this book and the 70-410 exam objectives:

- *Chapter objectives*—Each chapter begins with a detailed list of the concepts to be mastered. This list is a quick reference to the chapter's contents and a useful study aid.

- *Hands-on activities*—More than 130 hands-on activities are incorporated in this book, giving you practice in setting up, configuring, and managing a Windows Server 2012/R2 server. The activities give you a strong foundation for carrying out server installation and configuration tasks in production environments. Much of the learning about Windows Server 2012/R2 comes from doing the hands-on activities, and a lot of effort has been devoted to making the activities relevant and challenging.
- *A requirements table for hands-on activities*—A table at the beginning of each chapter lists the hands-on activities and what you need for each activity.
- *Screen captures, illustrations, and tables*—Numerous screen captures and illustrations of concepts help you visualize theories and concepts and see how to use tools and desktop features. In addition, tables are used often to give you details and comparisons of practical and theoretical information and can be used for a quick review.
- *Chapter summary*—Each chapter ends with a summary of the concepts introduced in the chapter. These summaries are a helpful way to recap and revisit the material covered in the chapter.
- *Key terms*—All terms in the chapter introduced with bold text are gathered together in the Key Terms list at the end of the chapter. This list gives you a way to check your understanding of all important terms.
- *Review questions*—The end-of-chapter assessment begins with review questions that reinforce the concepts and techniques covered in each chapter. Answering these questions helps ensure that you have mastered important topics.
- *Case projects*—Each chapter closes with one or more case projects. Many of the case projects build on one another, as you take a small startup company to a flourishing enterprise.
- *On the DVD*—The DVD includes a free 120-day evaluation copy of Windows Server 2012 R2, Datacenter Edition.

Text and Graphics Conventions

Additional information and exercises have been added to this book to help you better understand what's being discussed in the chapter. Icons throughout the book alert you to these additional materials:

Tips offer extra information on resources, how to solve problems, and time-saving shortcuts.

Notes present additional helpful material related to the subject being discussed.

The Caution icon identifies important information about potential mistakes or hazards.

Each hands-on activity in this book is preceded by the Activity icon.

Case Project icons mark the end-of-chapter case projects, which are scenario-based assignments that ask you to apply what you have learned in the chapter.

CertBlaster Test Preparation Questions

MCSA Guide to Installing and Configuring Microsoft® Windows Server® 2012/R2, Exam 70-410 includes CertBlaster test preparation questions for the 70-410 MCSA exam. CertBlaster is a powerful online certification preparation tool from dti Publishing that mirrors the look and feel of the certification exam.

To log in and access the CertBlaster test preparation questions for *MCSA Guide to Installing and Configuring Microsoft® Windows Server® 2012/R2, Exam 70-410*, go to *www.certblaster.com/login/*. The CertBlaster user's online manual describes features and gives navigation instructions. Activate your CertBlaster license by entering your name, e-mail address, and access code (found on the card bound in this book) in their fields, and then click Submit. CertBlaster offers three practice modes and all the types of questions required to simulate the exams:

- *Assessment mode*—Used to determine the student's baseline level. In this mode, the timer is on, answers aren't available, and the student gets a list of questions answered incorrectly, along with a Personal Training Plan.
- *Study mode*—Helps the student understand questions and the logic behind answers by giving immediate feedback both during and after the test. Answers and explanations are available. The timer is optional, and the student gets a list of questions answered incorrectly, along with a Personal Training Plan.
- *Certification mode*—A simulation of the actual exam environment. The timer as well as the number and format of questions from the exam objectives are set according to the exam's format.

For more information about dti test prep products, visit the Web site at *www.dtipublishing.com*.

Instructor Companion Site

Everything you need for your course in one place! This collection of book-specific lecture and class tools is available online via *www.cengage.com/login*. Access and download PowerPoint presentations, images, the Instructor's Manual, and more.

- *Electronic Instructor's Manual*—The Instructor's Manual that accompanies this book includes additional instructional material to assist in class preparation, including suggestions for classroom activities, discussion topics, and additional quiz questions.
- *Solutions Manual*—The instructor's resources include solutions to all end-of-chapter material, including review questions and case projects.
- *Cengage Learning Testing Powered by Cognero*—This flexible, online system allows you to do the following:
  - Author, edit, and manage test bank content from multiple Cengage Learning solutions.
  - Create multiple test versions in an instant.
  - Deliver tests from your LMS, your classroom, or wherever you want.
- *PowerPoint presentations*—This book comes with Microsoft PowerPoint slides for each chapter. They're included as a teaching aid for classroom presentation, to make available to students on the network for chapter review, or to be printed for classroom distribution. Instructors, please feel free to add your own slides for additional topics you introduce to the class.
- *Figure files*—All the figures and tables in the book are reproduced in bitmap format. Similar to the PowerPoint presentations, they're included as a teaching aid for classroom presentation, to make available to students for review, or to be printed for classroom distribution.

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Finally, my family: My wife, Julie; daughters Camille and Sophia; and son, Michael, deserve special thanks and praise for going husbandless and fatherless 7 days a week, 14 hours a day, for the better part of a year. Without their patience and understanding and happy greetings when I did make an appearance, I could not have accomplished this.

About the Author

Greg Tomsho has more than 30 years of computer and networking experience and has earned the CCNA, MCTS, MCSA, A+, Security+, and Linux+ certifications. Greg is the director of the Computer Networking Technology Department and Cisco Academy at Yavapai College in Prescott, AZ. His other books include *MCSA Guide to Administering Windows Server 2012/R2, Exam 70-411*, *MCTS Guide to Microsoft Windows Server 2008 Active Directory Configuration*, *MCTS Guide to Microsoft Windows Server 2008 Applications Infrastructure Configuration*, *Guide to Networking Essentials*, *Guide to Network Support and Troubleshooting*, and *A+ CoursePrep ExamGuide*.

Contact the Author

I would like to hear from you. Please e-mail me at *w2k12@tomsho.com* with any problems, questions, suggestions, or corrections. I even accept compliments! Your comments and suggestions are invaluable for shaping the content of future books. You can also submit errata, lab suggestions, and comments via e-mail. I have set up a Web site to support my books at *http://books.tomsho.com*, where you'll find lab notes, errata, Web links, and helpful hints for using my books. If you're an instructor, you can register on the site to contribute articles and comment on articles.

Before You Begin

Windows Server has become more complex as Microsoft strives to satisfy the needs of enterprise networks. In years past, you could learn what you needed to manage a Windows Server-based network and pass the Microsoft certification exams with a single server, some good lab instructions, and a network connection. Today, as you work with advanced technologies—such as Hyper-V, Storage Spaces, and DirectAccess, just to name a few—your lab environment must be more complex, requiring two or even three servers and at least one client computer. Setting up this lab environment can be challenging, and this section was written to help you meet this challenge. Using virtual machines in VMware Workstation or VMware Player is highly recommended; other virtual environments work, too, but VMware allows you to install Hyper-V on a virtual machine. Hyper-V is used in Chapter 12.

If you can't set up a lab environment exactly as described in this section, you still have some options to help you gain the skills learned through hands-on activities:

- *Configure a partial lab*—If you have just one Windows Server 2012 R2 server available, you can still do many of the hands-on activities. Having one server and one client is even better, and having two servers and one client enables you to do the majority of the book's activities. If you can't do an activity, it's important to read the activity steps to learn important information about Windows Server 2012/R2.

- *Purchase the Web-Based Labs*—Cengage Learning offers Web-Based Labs for this book. This product gives you access to a real lab environment over the Internet by using a Web browser. Step-by-step lab instructions are taken directly from the hands-on activities in the book. See your sales representative or the Cengage Learning Web site for more information.

Lab Setup Guide

The lab equipment for hands-on activities consists of four computers (three of which are servers) and one client OS. One server with Windows Server 2012 R2 should be configured before doing the hands-on activities in Chapter 1. A client computer with Windows 8.1 Enterprise Edition should be available starting with Chapter 5. In Chapter 2, you install Windows Server 2012 R2 and Windows Server 2012 R2 Server Core on two additional servers. Figure 1 shows a diagram of the network.

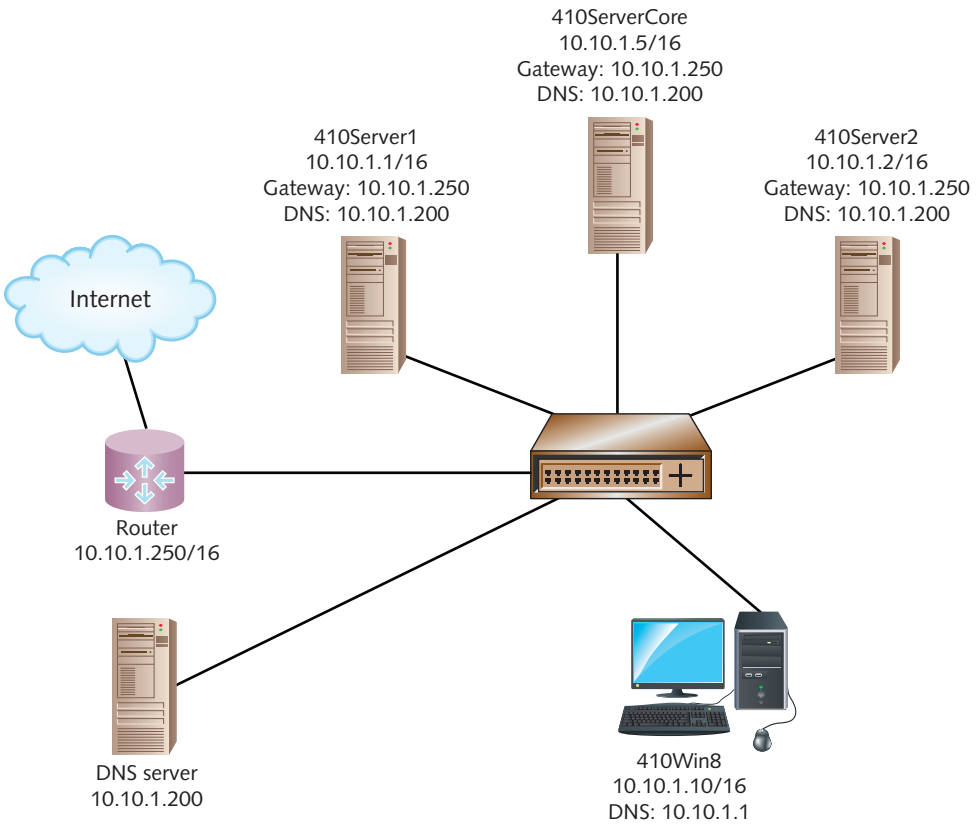

Figure 1 A diagram of the lab configuration

A few words about this diagram:

- The router address is suggested, but you can use a different address. You can do most activities without a router to the Internet, except those requiring Internet access.
- The DNS server address is suggested, but you can use a different address. The DNS server should have a zone named 410Server2012.local configured to accept unsecured updates. This DNS server is needed in only a few activities, mainly Chapter 3 when you're configuring server management. You can still do the activities without a DNS server but need to use IP addresses instead of server names when called for.

- Only 410Server1 must have an OS installed and configured before starting activities in Chapter 1.
- 410Server2 and 410ServerCore are installed and configured in Chapter 2.
- There's no activity to install Windows 8.1 on 410Win8, but it should be installed before Chapter 5, when it's first used.
- Specific installation requirements for each server are explained in the following sections.

410Server1

This server should be configured as follows before beginning the activities in Chapter 1:

- Windows Server 2012 R2 Standard or Datacenter
- Server name: 410Server1
- Administrator password: Password01
- Memory: 1 GB or more
- Hard disk 1: 60 GB or more
- Hard disk 2: 60 GB or more
- Network interface card
- Workgroup: 410Server2012
- Primary DNS suffix: 410Server2012.local (To set it, right-click Start, click System, click Change settings, click Change, and click More. Restart the server after changing the suffix.)
- Chapter 4 requires installing a third HDD. If you're using virtualization, you can just add the new virtual disk with the virtualization software. If you're using physical servers, you need another disk to install in the server.
- IP address: 10.10.1.1/16
- Default gateway: 10.10.1.250 (or an address supplied by the instructor)
- DNS: 10.10.1.200 or the address of a DNS server on your network that accepts unsecured dynamic updates and has a zone named 410Server2012.local
- Windows Update: Not configured
- The network location must be set to Private. To change the network location from Public to Private, if necessary, follow these steps:

1. Open Server Manager, and click **Tools**, **Local Security Policy** from the menu.
2. In the Local Security Policy console, click **Network List Manager Policies**. Double-click **All Networks**, and in the Network location section, click **User can change location**. Click **OK**.
3. Double-click the network you're connected to. (If you aren't sure, open the Network and Sharing Center, which shows the name of the network and whether it's configured as a Public, Private, or Domain network.)
4. In the Network Location tab, click the **Private** option button, and click **OK.**

- If you're using an evaluation version of Windows Server 2012 R2, you can rearm the evaluation up to five times. To do so, follow these steps:

1. Open a command prompt window as Administrator.

2. Type **`slmgr -xpr`** and press **Enter** to see the current status of your license. It shows how many days are left in the evaluation. If it says you're in notification mode, you need to rearm the evaluation immediately.

3. To rearm the evaluation, type **`slmgr -rearm`** and press **Enter**. You see a message telling you to restart the system for the changes to take effect. Click **OK** and restart the system.

410Server2

No OS is installed before beginning the activities. You install Windows Server 2012 R2 on 410Server2 in Chapter 2, Activity 2-1. Hyper-V is installed on this machine in Chapter 12, so it must meet the requirements for Hyper-V installation. You can install the Hyper-V role on VMs running in VMware Workstation 9 and later with the right hardware support, but it's not officially supported.

The configuration settings are done in the activities. They're listed here just for your information:

- Server name: 410Server2
- Administrator password: Password01
- Memory: 1 GB or more (4 GB or more for the Hyper-V activities in Chapter 12)
- Hard disk 1: 60 GB or more
- Hard disk 2: 60 GB or more
- Network interface card
- Workgroup: 410Server2012
- Primary DNS suffix: 410Server2012.local
- IP address: 10.10.1.2/16
- Default gateway: Same as for 410Server1
- DNS: Same as for 410Server1
- The network location must be set to Private. To change the network location from Public to Private, see the instructions for 410Server1.

410ServerCore

No OS is installed before beginning the activities. You install Windows Server 2012 R2 Server Core on this machine in Chapter 2, Activity 2-7.

The configuration settings are done in the activities. They're listed here just for your information:

- Server name: 410ServerCore
- Administrator password: Password01
- Memory: 1 GB or more
- Hard disk 1: 60 GB or more
- Network interface card
- Workgroup: 410Server2012
- Primary DNS suffix: 410Server2012.local
- IP address: 10.10.1.5/16
- Default gateway: Same as for 410Server1
- DNS: Same as for 410Server1
- The network location must be set to Private. To change the network location from Public to Private, see the instructions for 410Server1.

410Win8

This computer should be configured as follows before beginning Chapter 5:

- Windows 8.1 Enterprise Edition
- Machine name: 410Win8

- Local administrator account with the username Win8User and the password Password01
- Memory: 1 GB or more
- Hard disk 1: 60 GB or more
- Network interface card
- Workgroup: 410Server2012
- Settings: Express settings
- Sign in without a Microsoft account
- IPv4 address: 10.10.1.10/16
- Default gateway: Same as for 410Server1
- DNS: The IP address of 410Server1 (10.10.1.1)
- Windows Update: Not configured

Here are some additional recommended requirements:

- A router to the Internet. The recommended address is 10.10.1.250/16, but any address in this subnet will work.
- A DNS server with a zone named 410Server2012.local.

Deployment Recommendations

Using virtualization to configure your lab environment is recommended. If you're using physical computers, the requirements are much the same, but you need many more physical computers. If you're using physical computers, you can set up the network as shown previously in Figure 1 and configure the computers as described earlier.

Avoiding IP Address Conflicts

Whether you're using physical computers or virtual computers, you must have a method for avoiding IP address conflicts. There are two setups for working in a classroom environment:

- *All students computers are on the same physical subnet*—In this setup, IP addresses and computer names must be changed to avoid conflict. One strategy for avoiding IP address conflicts is using the third octet of the address. Each student is assigned a number, such as one from 1 to 50. When assigning IP addresses, simply change the third octet to the student-assigned number. For example, for student 15, address 10.10.1.1 becomes 10.10.15.1. Use the same number as a suffix for the computer and domain names. For example, 410Server1 becomes 410Server1-15, 410Server1-16, and so forth. The domain name also changes accordingly, such as 410Server2012-15.local, 410Server2012-16.local, and so on.
- *Each student works in a "sandbox" environment*—This setup is preferred, if it's possible. A router using NAT separates each student's sandboxed network environment, so there are no conflicts. This setup is easier to configure with virtualization. One possibility, as described later in the "Sample Configuration for Virtualization" section, is to configure an extra Windows Server 2012 VM as a NAT router with RRAS and as a DNS server. This machine can then route from the private network to the public Internet when needed. It also serves as the initial DNS server required for some activities, but its main purpose is to hide students' VMs from each other so that there are no address or name conflicts.

Using Virtualization

Using virtualization is highly recommended, and you have the following options for virtualization software:

- *VMware Workstation*—This sophisticated virtualization environment is a free download if your school or organization is a member of the VMware Academic Program (*http://vmapss.onthehub.com*). The advantage of VMware Workstation is that you can take periodic snapshots of VMs and revert to one if something goes wrong with a virtual machine. In addition, you can install Hyper-V in a virtual machine with just a few tweaks to the VM configuration if your host supports it. You can find instructions for installing Hyper-V in a VMware virtual machine at *http://4sysops.com/archives/how-to-run-hyper-v-under-vmware-workstation/*.
- *VMware Player*—This product is a free download from the VMware Web site. You can't take snapshots, but otherwise, it's an excellent virtual environment.
- *Hyper-V*—If you install Windows Server 2012 R2 or Windows 8.1 on your host computers, you can run Hyper-V as your virtual environment. The advantage of using Hyper-V is that you can do the Hyper-V activities in Chapter 12 without any additional configuration. The disadvantage of using Hyper-V is that you need Administrator access to your host computers to use Hyper-V Manager.
- *VirtualBox*—This excellent open-source virtualization product from Oracle has many advanced features, as VMware Workstation does, but it's free. However, it doesn't support running Hyper-V on a virtual machine.

Host Computer Requirements When Using Virtualization

The following are recommendations for the host computer when you're using virtualization:

- Dual-core or quad-core CPU with Intel-VT-x/EPT or AMD-V/RVI support. You can see a list of supported Intel processors at *http://ark.intel.com/products/virtualizationtechnology*.

Most activities can be done without a CPU that supports EPT, but you can't install Hyper-V on a VM if the host doesn't support EPT for Intel CPUs or RVI on AMD CPUs.

- 8 GB RAM.

Most activities can be done with 4 GB RAM installed on the host. Only those requiring three VMs running at the same time need more than 4 GB.

- 150 GB free disk space.
- Windows 7 or Windows 8/8.1 if you're using VMware Workstation, VMware Player, or VirtualBox.
- Windows Server 2012 R2 or Windows 8.1 Pro or Enterprise 64-bit if you're using Hyper-V.

Sample Configuration for Virtualization

Figure 2 shows a diagram of a setup that includes a virtual machine acting as a router and DNS server. The virtual networks are labeled for both a Hyper-V implementation and a VMware implementation. (The Server Core server isn't shown in this diagram.) The virtual machine set up as a router has two virtual NICs, one connected to the private network with lab computers and one connected to an external (Hyper-V) or bridged (VMware) network that connects to the physical network. The router VM is running RRAS and NAT for routing and DNS with the 410Server2012.local zone.

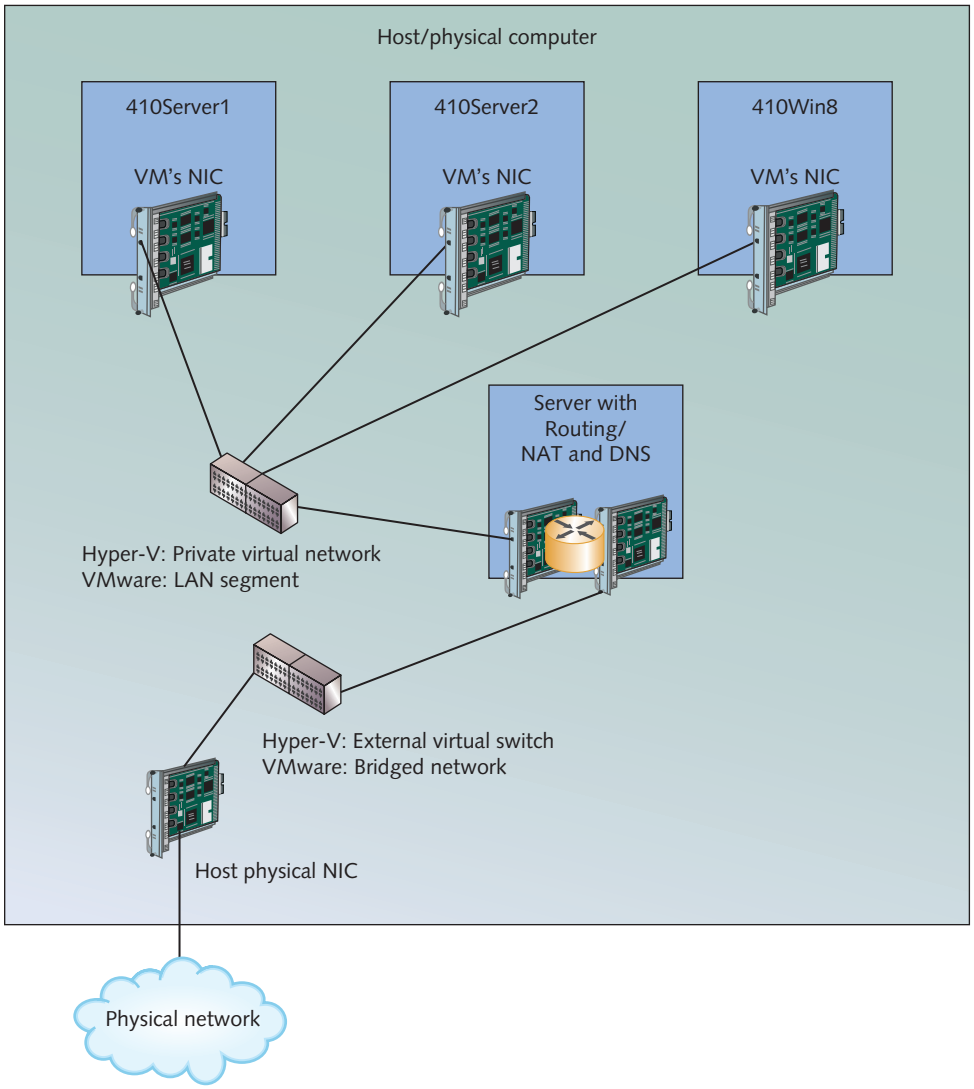

Figure 2 A sample virtual lab configuration

Where to Go for Help

Configuring a lab and keeping everything running correctly can be challenging. Even small configuration changes can prevent activities from running correctly. If you're using virtualization, use snapshots if possible so that you can revert virtual machines to an earlier working state in case something goes wrong. The author maintains a Web site that includes lab notes, suggestions, errata, and help articles that might be useful if you're having trouble, and you can contact the author at these addresses:

- Web site: *htttp://books.tomsho.com*
- E-mail: *w2k12@tomsho.com*

chapter 1

Introducing Windows Server 2012/R2

After reading this chapter and completing the exercises, you will be able to:

- Explain the function of a server operating system in a network
- Describe the editions of Windows Server 2012/R2
- Define private cloud terms and technologies
- Explain the core technologies of Windows Server 2012/R2
- Describe Windows Server 2012/R2 roles
- Summarize the new and enhanced features of Windows Server 2012/R2

All screenshots, unless otherwise noted, are used with permission from Microsoft Corporation.

Windows Server 2012/R2 is Microsoft's deep dive into the private cloud. This new version is chock-full of new tools and features designed to help server administrators increase the availability of network services and limit security risks. Microsoft has also emphasized features that help datacenter operators deploy and manage a private cloud.

Most networks are set up so that the people using computers on them can communicate with one another easily. One of a server's functions is to facilitate communication between computers and, therefore, between people. The administrator of a computer network has the job of configuring servers and computers on the network to provide services that facilitate this communication. These services include, but aren't limited to, file sharing, device sharing (such as printers and storage), security, messaging, remote access, Web services, and services that work in the background to ensure a user-friendly and secure experience.

This chapter discusses the editions of Windows Server 2012/R2 and the requirements and uses for each. In addition, you learn about the roles a server operating system plays in a computer network and the many features in Windows Server 2012/R2 designed to fill these roles. With Microsoft's emphasis on Windows Server 2012's role in the private cloud, this chapter also defines cloud computing and some terms associated with this collection of technologies.

This book covers Windows Server 2012 and the newer Windows Server 2012 R2. When a topic or feature is relevant to both the original release of Windows Server 2012 and R2, the name Windows Server 2012/R2 is used. If a feature is particular to the R2 version, Windows Server 2012 R2 is used (without the "/" character). Microsoft has added a number of enhancements in Windows Server 2012 R2, and the new and modified features will have found their way into the Windows Server 2012 certification exams by the time this book is published.

About the Hands-On Activities

Be sure to read and complete the activities in the "Before You Begin" section of the Introduction. The hands-on activities in this chapter and all that follow require setting up your lab environment so that it's ready to go. The hands-on activities in this chapter use 410Server1, a Windows Server 2012 R2 Standard or Datacenter Edition computer that's already installed and initially configured. The "Before You Begin" section gives you step-by-step instructions on setting up your lab for use with all activities in this book.

Completing the hands-on activities in this book is important because they contain information about how Windows Server 2012/R2 works and the tools to manage it that's best understood by hands-on experience. If, for some reason, you can't do some of the activities, you should at least read through each one to make sure you don't miss important information. Table 1-1 summarizes the requirements of hands-on activities in this chapter.

Table 1-1 Activity requirements

Activity	Requirements	Notes
Activity 1-1: Reviewing System Properties	410Server1	Windows Server 2012 R2 Standard or Datacenter Edition installed according to instructions in "Before You Begin"
Activity 1-2: Exploring Server Manager	410Server1	
Activity 1-3: Examining NTFS Permissions and Attributes	410Server1	
Activity 1-4: Using a Prebuilt MMC	410Server1	
Activity 1-5: Creating a Custom MMC	410Server1	
Activity 1-6: Introducing the Disk Management Snap-in	410Server1	A second, uninitialized disk should already be installed in 410Server1
Activity 1-7: Comparing NTFS and FAT32 Volumes	410Server1	

(continues)

Activity	Requirements	Notes
Activity 1-8: Sharing a Folder in Windows Server 2012	410Server1	
Activity 1-9: Exploring Windows Networking Components	410Server1	

The Role of a Server Operating System

A server or collection of servers is usually at the center of most business networks. The functions a server performs depend on a number of factors, including the type of business using the server, size of the business, and extent to which the business has committed to using technology to aid operations. The latter factor is the crux of the matter. Technology is designed to help a person or an organization do things more efficiently or more effectively, and a server is used to provide services a business has deemed can help its operations. Before you explore these services in more detail, a few definitions are in order.

Server: Hardware or Software?

When most people hear the word "server," they conjure up visions of a large tower computer with lots of hard drives and memory. This image is merely a computer hardware configuration that may or may not be used as a server, however. In short, a computer becomes a server when software is installed on it that provides a network service to client computers. In other words, you could install certain software on an inexpensive laptop computer and make it act as a server. By the same token, a huge tower computer with six hard drives and 128 GB of RAM could be used as a workstation for a single user. So although some computer hardware configurations are packaged to function as a server, and others are packaged as desktop computers, what makes a computer a server or desktop computer is the software installed on it.

Of course, with modern operating systems (OSs), the lines between desktop and server computer are blurred. OSs such as Windows 8.1 and its predecessors are designed to be installed on desktop computers or workstations (and in the case of Windows 8.1, tablet computers); to run Web browser, word processing, spreadsheet, and other similar programs; and generally act as a personal computer. However, these OSs can perform server functions, such as file and printer sharing, and even act as a Web server. On the other hand, Windows Server 2012/R2 and its predecessors are designed as **server operating systems**, but there's nothing to stop you from installing a word processor or Web browser and using Windows Server 2012/R2 on your desktop computer. So what are the differences between a desktop OS, such as Windows 8.1, and a server OS, such as Windows Server 2012? The following section explains.

Server Operating Systems Versus Desktop Operating Systems

Both Windows Server 2012/R2 and Windows 8.1 can perform some server functions and some desktop functions, but important differences distinguish them. Windows 8.1 is configured to emphasize the user interface and is performance-tuned to run desktop applications. Windows Server 2012/R2, on the other hand, deemphasizes many of Windows 8.1's user interface bells and whistles in favor of a less flashy and less resource-intensive user interface. In addition, Windows vServer 2012/R2 is performance-tuned to run background processes so that client computers can access network services faster. Speaking of network services, most Windows Server 2012/R2 editions can run the following network services, among others:

- File and Printer Sharing
- Web Server
- Routing and Remote Access Services (RRAS)
- Domain Name System (DNS)
- Dynamic Host Configuration Protocol (DHCP)
- File Transfer Protocol (FTP) Server
- Active Directory

- Distributed File System (DFS)
- Hyper-V
- Fax Server

Of these services, Windows 8.1 supports only Hyper-V, File and Printer Sharing, Web Server, and FTP Server and in a limited capacity. In addition, Windows 8.1 is restricted to 20 logged-on network users, whereas on a Windows Server 2012/R2 computer running Standard or Datacenter Edition, logged-on users are limited only by the number of purchased licenses and available resources. In addition, because a server is such a critical device in a network, Windows Server 2012/R2 includes fault-tolerance features, such as redundant array of independent disks (RAID) 5 volumes, load balancing, and clustering, which aren't standard features in Windows 8.1 or other Windows desktop OSs. Windows Server 2012/R2 is also capable of supporting up to 64 processors; Windows 8.1 supports a maximum of 2.

Windows Server 2012/R2 Editions

In the realm of server OSs, Microsoft has an edition for all types of business, large and small. Businesses can choose the best solution for their size and the services they require. From a simple file-sharing server to a massive virtualization server, Windows Server 2012/R2 has it covered. The Windows Server 2012/R2 editions have been streamlined compared with Windows Server 2008:

- Datacenter
- Standard
- Essentials
- Foundation

Why the need for several editions? One size doesn't fit all is the short answer. For example, a small organization with a dozen users who mainly need a centralized network logon along with file and printer sharing can probably use Foundation Edition. A large company or one that needs a robust application server might opt for Standard Edition. A company with hundreds or thousands of users that's implementing a private cloud solution will likely opt for Datacenter Edition. As server virtualization has become an essential part of the Server 2012 family of products, there are important differences in editions for support of the Hyper-V role. The following sections review the features and requirements of the four Windows Server 2012/R2 editions.

Datacenter and Standard Editions

Both Datacenter and Standard editions are full-featured server OSs with only the virtual use limits setting them apart. For organizations using virtualization on a large scale, **Datacenter Edition** is clearly the best fit. A Datacenter Edition license allows you to install an unlimited number of virtual instances of the OS, meaning you can install Datacenter Edition with Hyper-V on a physical server and then install as many instances of Windows Server 2012/R2 Datacenter Edition in virtual machines as you need. You must purchase one Datacenter Edition license for every two physical processors installed on a server. So if you have a physical server with one or two populated CPU sockets, you need one Datacenter Edition license. If your server has three or four populated CPU sockets, you need two Datacenter Edition licenses, and so forth. The number of CPU cores is irrelevant in the licensing; only physical CPU sockets are counted. So, for example, if your server has two eight-core processors installed, you still need just one Datacenter Edition license.

Standard Edition has all the features of Datacenter Edition and the same processor licensing conditions. The only distinction (aside from price) is that a Standard Edition license permits only two virtual instances, so when you purchase Standard Edition, you can install it on a server with up to two populated CPU sockets, install the Hyper-V role, and then install Standard Edition on up to two virtual machines. If you want to install it on a server with more than two processors or on additional virtual machines, you must purchase additional licenses. Hyper-V is described later in this chapter in "Windows Server 2012/R2 Roles."

Both Datacenter and Standard editions support up to 4 TB of RAM, up to 64 physical processors, and server clusters with up to 64 nodes per cluster. When you install either edition of Windows Server 2012, you have an option to install it without the standard graphical user interface (GUI), a mode called Server Core. Server Core is now the default, and preferred, operating mode and is described later in this chapter in "New and Enhanced Features in Windows Server 2012/R2."

In addition, all Windows Server 2012/R2 server roles and features are supported in both editions, and either edition can be configured as a domain controller, member server, or stand-alone server. Both editions require **client access licenses (CALs)**, which are legally mandated for each user who logs on to the server.

Datacenter Edition, as of this writing, costs about $3800, roughly five times the cost of Standard Edition, which can be purchased for around $750. CALs are about $125/license in small quantities.

Essentials Edition

Essentials Edition is aimed at small businesses with 25 or fewer users. It supports most of the roles and features in Standard and Datacenter editions, but some roles have restrictions or limited functions. In the original release of Windows Server 2012, the Hyper-V role couldn't be installed on Essentials Edition, but it's available in the R2 release. For the price of the license (typically around $500), you can install Essentials Edition one time on a physical server or a virtual machine, but not both. Essentials Edition is automatically configured as a **root domain controller**, which is the first domain controller installed in an Active Directory forest. During installation of Essentials Edition, you're asked for the domain name, and Active Directory is installed automatically. Several other services are configured automatically in this edition: Active Directory Certificate Services, DNS, File Services, Web Server (IIS), Network Policy Server, and Remote Desktop Services. In addition, Essentials Edition comes with a front-end management interface called Dashboard that serves as a simplified server manager. Other features particular to this edition include client backups and Remote Web Access. This edition supports up to two physical processors and 64 GB RAM and can't be installed in Server Core mode. No CALs are required. In the R2 release of this edition, Office 365 integration and touch-enabled Remote Web Access have been added.

A new feature of Windows Server 2012 R2 that's not in the original release is the server role Windows Server Essentials Experience. Available in Standard and Datacenter editions, it includes the features and functions of Windows Server 2012 Essentials (such as automatic Active Directory configuration, the Dashboard view of Server Manager, client backup, and Remote Web Access), along with other preconfigured roles and features, and doesn't have the user and hardware limitations of Essentials Edition.

Foundation Edition

Foundation Edition, the entry-level Windows Server 2012/R2 edition, is suitable for small businesses that need to purchase a complete server solution for file and printer sharing, centralized control over user accounts and network resources, and common services used in most networks, such as Web services, DNS, and DHCP. Foundation Edition is available as an OEM version only, installed on a server by the manufacturer. The licensing is limited to 15 users, and like Essentials, no CALs are required.

Foundation Edition supports a single physical processor; like the other editions, the number of CPU cores is irrelevant. It supports up to 32 GB RAM and can be configured as a stand-alone server or a root domain controller. This edition can't be installed in Server Core mode, can't be installed in a virtual machine, and doesn't support Hyper-V.

Comparing Editions

Tables 1-2 and 1-3 summarize system requirements and compare features of the Windows Server 2012/R2 editions.

For an extensive comparison of Windows Server 2012/R2 editions, go to *www.microsoft.com/windowsserver2012/editions/overview.mspx*.

Table 1-2 Windows Server 2012/R2 minimum system requirements (all editions unless noted)

Component	Requirement
Processor	Minimum: 1.4 GHz 64-bit CPU Recommended: 3.1 GHz or faster 64-bit multicore
Memory	Minimum: 512 MB RAM (2 GB for Essentials) Recommended: 2 GB RAM or more (8 GB for Essentials)
Available disk space	Minimum: 32 GB (90 GB for Essentials) Recommended: 60 GB or more for the system partition
Additional drives	DVD drive
Network interface card	Gigabit (10/100/1000 BaseT) Ethernet Adapter
Display and peripherals	Super VGA or higher Keyboard and mouse Internet access

The minimum requirements for Essentials are higher than for the other editions because Essentials installs several network services automatically.

Roles not listed in Table 1-2 are fully supported by all editions.

Table 1-3 Comparing features in Windows Server 2012/R2 editions

Feature	Datacenter	Standard	Essentials	Foundation
Maximum RAM	4 TB	4 TB	64 GB	32 GB
Supported processor sockets	64	64	2	1
Virtual licenses	Can be a virtualization host Unlimited virtual instances	Can be a virtualization host 2 virtual instances	Can't be a virtualization host 1 virtual or 1 physical instance	Not available
Processor socket licensing	Each license supports two sockets	Each license supports two sockets	Maximum two sockets per system	Maximum one socket per system
Supported role limitations				
Active Directory Domain Services	No limitations	No limitations	Automatic/forest root only	Forest root only
Active Directory Certificate Services	No limitations	No limitations	Automatic/CA creation only	CA creation only
File and Storage Services	No limitations	No limitations	Data deduplication not available	Data deduplication not available
Hyper-V	No limitations	No limitations	No limitations	Not available
Read-only domain controller	No limitations	No limitations	Not available	Not available
Data deduplication	No limitations	No limitations	Not available	Not available
Failover clustering	No limitations	No limitations	Not available	Not available

(continues)

Feature	Datacenter	Standard	Essentials	Foundation
Hot add memory	No limitations	No limitations	Not available	Not available
Remote Access	No limitations	No limitations	Automatic/limited	Limited
Remote Desktop Services	No limitations	No limitations	Automatic/limited	Limited
Network Policy and Access Services	No limitations	No limitations	Automatic/limited	Limited
Windows Server Update Services	No limitations	No limitations	No limitations	Not available
Server Core mode	No limitations	No limitations	Not available	Not available

Windows Server 2012/R2 and the Private Cloud

With Microsoft's new emphasis on the private cloud and virtualization, it's probably a good idea to define some terms used when talking about the private cloud and cloud computing in general. Many of these terms and concepts are expanded on later as you learn about the technologies behind them, but this section should give you a running start.

So what exactly is cloud computing? This question isn't as easy to answer as it might seem, and you're likely to get different answers from different people. However, most networking professionals are likely to agree with this definition: **Cloud computing** is a collection of technologies for abstracting the details of how applications, storage, network, and other computing resources are delivered to users. Why the term "cloud"? It comes from network diagrams that included the Internet (see Figure 1-1), and because the Internet is a vast collection of different technologies, no single networking symbol could be used to represent it. So a cloud symbol conveys that a lot of complex stuff is going on, but the details are unimportant at this time. One goal of cloud computing is to abstract the details of how things get done so that people can get on with their work. For example, do users really care that the X drive is mapped to ServerA by using the SMB protocol over TCP/IP? No, they want to store their files in a place they know is reliable and secure and would rather not know the details of how this task is done.

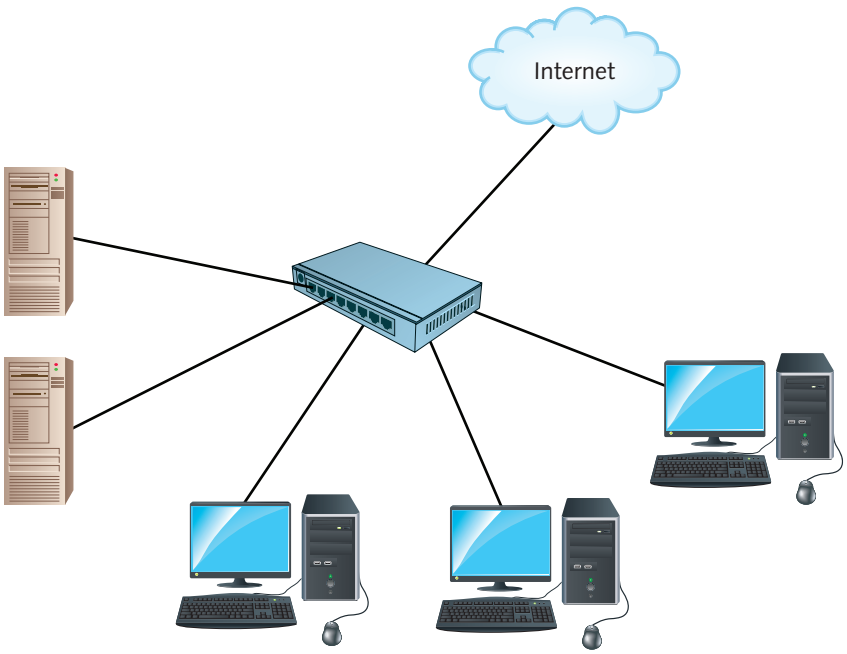

Figure 1-1 Network diagram with a cloud symbolizing the Internet

However, as an IT professional, you do need to know some details because setting up this technology is your job. A core technology of cloud computing is **virtualization**, which uses software (usually aided by specialized hardware) to emulate multiple hardware environments so that multiple operating systems can run on the same physical server simultaneously. Virtualization has its own terms for its operation and components. Some are defined in the following list:

- A **virtual machine (VM)** is the virtual environment that emulates a physical computer's hardware and BIOS. A **guest OS** is the operating system running in a VM.
- A **host computer** is the physical computer on which VM software is installed and VMs run.
- **Virtualization software** is the software for creating and managing VMs and creating the virtual environment in which a guest OS is installed. Microsoft Hyper-V Manager or VMware Workstation are examples of virtualization software.
- The **hypervisor** is the virtualization software component that creates and monitors the virtual hardware environment, which allows multiple VMs to share physical hardware resources. (In some software, this component is called Virtual Machine Monitor[VMM].) The hypervisor on a host computer acts in some ways like an OS kernel, but instead of scheduling processes for access to the CPU and other devices, it schedules VMs to have that access.

The preceding list is by no means exhaustive, and when you learn more about Hyper-V in Chapter 12, you run across more terms that are particular to virtualization.

Public Cloud Versus Private Cloud

There are two broad categories of cloud computing: public and private. The **public cloud** is a cloud computing service provided by a third party, whereas a **private cloud** is a cloud computing service provided by an internal IT department. Examples of public cloud computing are services such as DropBox and SkyDrive, which provide storage as a cloud service, or Google Apps and Office 365, which offer office applications as a cloud service. You don't have to do anything special to have access to these services (some of which are free) other than have access to the Internet.

With a private cloud, a company's IT department provides all services for employees and perhaps customers, but these services aren't generally open to the general public. Typical services include virtual desktops, storage, and applications. **Virtual desktop infrastructure (VDI)** is a rapidly growing sector of private cloud computing. With VDI, users don't run a standard desktop computer to access their data and applications. Instead, they connect to the private cloud with a Web browser or downloaded client software. They can then access their desktop and applications from wherever they happen to have an Internet connection, whether it's in their office, from a laptop in a local coffeeshop, or even from a tablet computer. The OS and applications run on servers in the company data center rather than on the local computer. Many of the new features and enhanced functions in Windows Server 2012/R2 are designed to make designing and building a private cloud easier and using cloud resources more efficient. The key feature for building private clouds in Windows Server 2012/R2 is Hyper-V 3.0, discussed later in this chapter in "New and Enhanced Features in Windows Server 2012/R2." All the core technologies in Windows Server 2012/R2, however, are necessary for running a cloud infrastructure. The following section explains these technologies.

Windows Server 2012/R2 Core Technologies

The new features and enhancements Microsoft added to Windows Server 2012/R2 command all the attention. Before you can understand and use these new features, however, you need a firm grasp of the technologies that form the foundation of a Windows Server OS. The following is a list of some of the technologies on which Windows Server 2012/R2 is built:

- Server Manager
- New Technology File System (NTFS)

- Active Directory
- Microsoft Management Console
- Disk Management
- File and printer sharing
- Windows networking

The following sections describe these technologies briefly, but most are covered in detail in later chapters.

Server Manager

Server Manager provides a single interface for installing, configuring, and removing a variety of server roles and features on your Windows server. It also summarizes your server's status and configuration and includes tools to diagnose problems, manage storage, and perform general configuration tasks. Server Manager has been substantially updated since its debut in Windows Server 2008. It can now be used to manage all servers in your network and access all the server administration tools from a single console.

When you start Server Manager, you see the Dashboard view, shown in Figure 1-2. The Dashboard shows a list of tasks you can perform, summarizes the installed roles, and shows the servers that are available to manage. The Welcome section can be hidden after you're familiar with Server Manager. This tool is used to access most of the configuration and monitoring tools for administering Windows servers, and you learn more about it throughout this book.

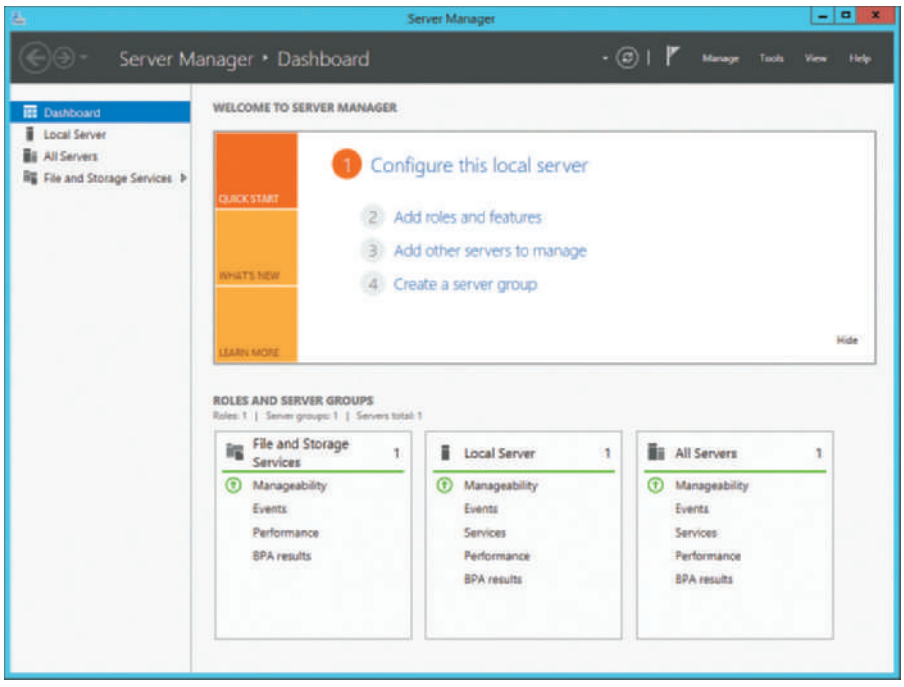

Figure 1-2 Server Manager Dashboard view

The forward and backward arrows at the upper left are used to navigate through recently opened windows. Moving to the right, your current location is displayed, followed by the refresh button and the notifications icon you click to view recent messages from Server Manager. Next is the Manage menu, used to perform major tasks, such as adding and removing roles and features and creating server groups. The Tools menu gives you quick access to administrative tools, such