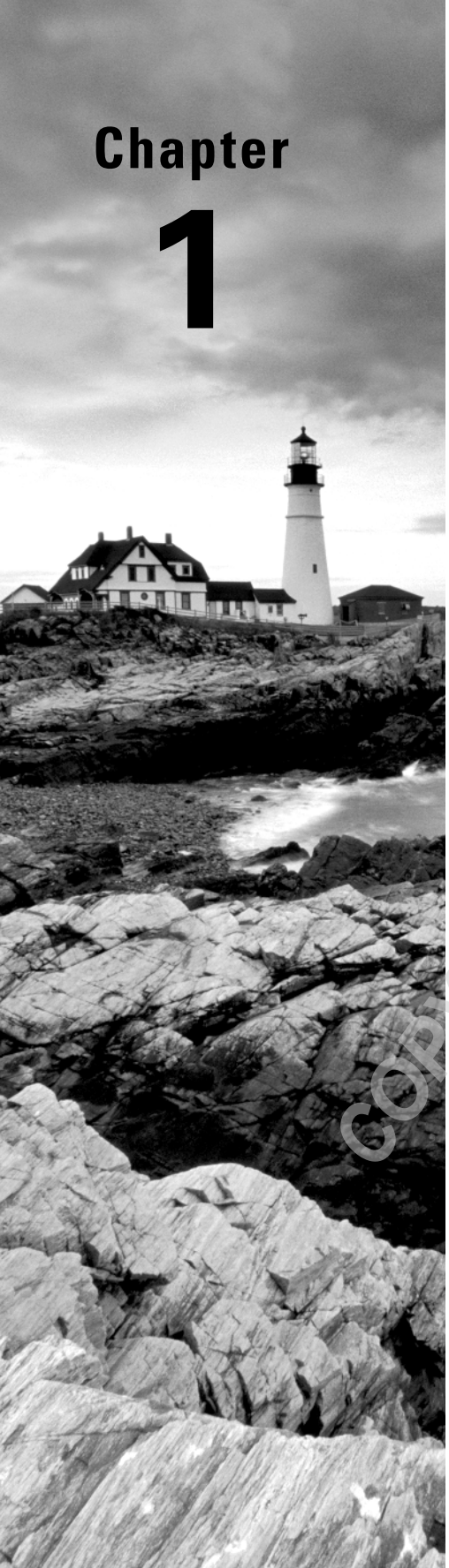


Chapter 1

Intro to Virtualization

THE VCA-DCV TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

✓ **Identify and explain the concept of data center virtualization**

- Explain data center virtualization
- Differentiate physical and virtual data center components
- Identify data center virtualization benefits

This chapter covers the basic concepts of data center virtualization and challenges addressed by that virtualization. You'll look at physical data center components and learn to differentiate between them. Then you will go over the advantages of data center virtualization and specific VMware products. (We discuss these specific products further in future chapters.) Finally, you will learn about some of the tools available online to help with the VCAD510 exam. By the end of this chapter, you will be able to define *data center virtualization*, differentiate between physical and virtual components, and list specific benefits of data center virtualization.

What Is Data Center Virtualization?

This section presents data center virtualization in a broad sense. It provides some background in order to give some context and introduces some of the vocabulary so you can join in on virtualization conversations around the water cooler.

The short explanation of *data center virtualization* is that it is a combination of physical hardware converted to software to allow greater utilization of the physical hardware, thereby increasing efficiency and reducing the amount of hardware needed. Data center virtualization is abstract—there is no physical entity that you can touch. Fortunately, virtual data center components can be considered the same as physical data center components. There are more similarities between a physical network card and a virtual network card than there are differences.

Today's modern data center includes virtualization at the root. Many devices that used to be physical can now exist totally in the virtual world. By leveraging virtualization, many logical devices can be created from one physical device. For example, the network card in a VMware ESXi host, through virtualization, can be many network cards—a virtual network card presented to each virtual machine on the host. Similarly, all the physical hardware devices that make up the physical host that is running the VMware hypervisor (ESXi) are presented to each virtual machine on the host.

The Hypervisor

In the VMware world, the *hypervisor* is the ESXi software. A hypervisor like ESXi plays the traffic cop for software resources. This allows multiple virtual machines to share the same physical hardware, which is the definition of consolidation.

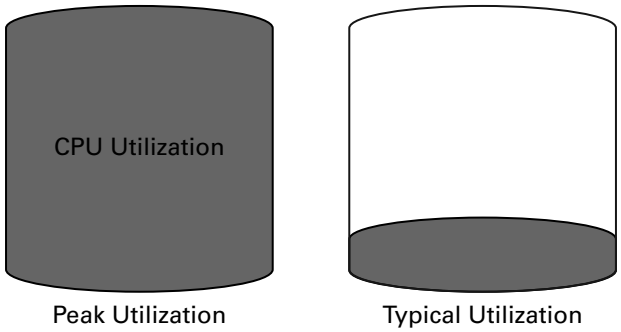
Of course, this is only where the good stuff starts.

Virtualization Then and Now

I have been working with computers for a really long time. When I started working with computers, a 10 MB hard drive provided a lot of storage. Most business computers had between 640 KB and 1 MB of memory. A lot has changed over the years, but one thing remains the same: businesses want to get as much return on investment as possible. It is easy to see the benefit of saving space or a little memory when you multiply that amount by a large number of computers. Not to mention the savings on data center power and cooling.

Back then, a company that specced out a new computer would have to buy a server that could handle the load at peak load time (Figure 1.1). That is, a server would have to be able to handle the most work requested of it at any given time. For example, if a new web server was needed, it might have to be able to handle 500 simultaneous users once a day. So, the new server would need to be big enough to handle that load even though that load occurred only once a day. As a result, companies typically had a large number of servers, and most of the servers were idle a lot of the time.

FIGURE 1.1 Before virtualization, servers were sized for peak load.



For this reason, virtualization makes a lot of sense. Virtualization is nothing new. Large mainframe companies such as IBM came up with the idea of virtualization decades ago and initially used it as a development environment more than anything else.

When virtualization started being leveraged in the PC world, it also was primarily used for development. When I started using VMware Workstation, it was an easy way to bring up an entire infrastructure on a PC. This represented a tremendous advantage. Now you can develop a solution that requires domain controllers, file servers, DNS servers, and application servers without buying a lot of hardware. Even when VMware ESX was released, many companies realized this could save them a lot of money but used it only for development environments. In fact, VMware once had an enterprise solution to provide developers with isolated environments. It was called VMware Lab Manager. Lab Manager was discontinued a few years ago. The functionality of Lab Manager was replaced by vCloud Director. However, vCloud Director requires Enterprise Plus licensing and takes some effort to reproduce what Lab Manager did.

Some companies, however, realized the potential of using VMware for real production environments. And the perception of VMware changed. Now, any company with a lot of servers has to at least entertain the idea of using virtualization. And companies that leverage virtualization see some amazing benefits. In fact, now the goal is more than a return on investment; it is the flexibility that virtualization provides along with some enterprise-level solutions from VMware.

I troubleshoot servers all day. When an application owner needs help with a server, I really hope it is a virtual server, because troubleshooting a virtual server can be much easier than troubleshooting a physical server. When troubleshooting a physical server, the problem is often a hardware or driver issue. I don't see, or rarely see, those kinds of problems with virtual servers. And, as the percentage of virtual servers increases in a company, some things just get easier. Now there is very little reason to have any physical application servers.

It was not too long ago that many companies deployed VMware but did not trust it enough to run business-critical applications such as enterprise email systems (for example, Microsoft Exchange) or enterprise database environments (for example, Microsoft SQL Server) on it. VMware made a push to change companies' minds and virtualize these busy servers. VMware made this push in different ways. But the one that counted was making VMware's products better. VMware is now more stable, scalable, and cost-effective. Many companies deploy Exchange and SQL Server, among other business-critical applications, on the VMware virtual platform. And VMware can dynamically scale resources to varying needs on the fly. For example, determining the right-sized physical server for running SQL can be difficult because demands on SQL can change so rapidly. You buy a brand new server to run SQL, and then six months later the physical server is not fast enough. With VMware, you can just increase the amount of memory installed or the number of CPUs. In fact, in some cases you can add memory or CPUs while the server is still running! I don't think you will ever try that with a physical server—at least, not more than once.

This section just scratched the surface of data center virtualization. But grasping the initial concepts is the first step: you should now know why virtualization started, its advantages, and why it is a big deal to companies. Next, we will talk about physical and virtual data center components and differentiating between the two.

Physical and Virtual Data Center Components

This section covers physical and virtual data center components and shows how to differentiate between the two.

Physical Data Center Components

Imagine a large data center in your company. There are many physical servers, each one running an operating system and installed applications. Each physical server has one or

more CPUs, memory, storage, and network ports. There are also physical network switches and storage devices. All of these things cost money and consume resources, such as power and cooling, that also cost money.

Physical data center components are physical in the sense that you can touch them. Pretty obvious, I know. However, to understand virtualization, you need to really think about what makes up physical components so it is easier to recognize virtual components and the role they play in the data center. When you open up a physical server, you can examine the hardware devices that make it work. There is a CPU, memory, network cards, and storage. Each of these can be represented by software in a virtual machine.

There are physical boxes in your data center such as servers, network switches, and storage devices. You can think of virtual components in a data center as completely replacing the physical counterparts. So, for example, when you are troubleshooting a virtual network card, you can think of what a physical network card does and expect the same exact properties and functionality in the virtual version.

Virtual Data Center Components

Virtual hardware components are software resources that provide virtual machines with a virtual copy of physical hardware. For example, the network port on a physical computer provides network communication. VMware created a driver for the network card that talks to the hypervisor (ESXi), and that same hypervisor talks to each virtual machine. On the virtual machine end of the hypervisor, everything is digital. There is no need for an actual network cable. A virtual machine running Windows 2012 has a virtual network card constructed of software in the network properties. This is the digital driver that VMware developed.

The ESXi hypervisor talks directly to the physical hardware of the host computer. The ESXi hypervisor also handles any requests from the operating system and installed applications within the virtual machine. The ESXi hypervisor acts as the perfect traffic cop between the physical host computer components and the virtual machine components.

The following are examples of virtual data center components:

- Network interface card
- Memory
- Hard drives
- CPU
- Server
- Network switch
- Network router

Notice that these are exactly the same as the physical devices. That is the point: the same devices providing the same resources, just in software.

On a physical server with an operating system and applications, the operating system handles communication from any installed application to the network card. So if you have

a dozen applications installed on a physical computer and all of them want to talk on the network, all of the network requests go to the operating system. And a network driver installed on an operating system further abstracts the physical network card. If you replace the network card on a physical computer with a different card, you will likely have to install a new driver for the network card. The installed applications on the physical server do not know or care that it is a different physical network card that it is talking to.

Some virtual data center components don't have a physical representation. For example:

- Cluster
- Data center
- vApp
- Distributed switch
- vCenter
- Template
- Other VMware appliances

A *cluster* is a group of servers running ESXi. By grouping the servers, you can manage their aggregate resources. If you have 10 physical ESXi hosts with 4 CPUs and 64 GB of memory each, you manage 40 CPUs and 640 GB of memory. VMware's vSphere features such as high availability (HA) and Distributed Resource Scheduler (DRS) work at the cluster level.

A *data center* is a logical grouping of folders and clusters. This logical grouping is used to separate clusters from each other. You can also leverage this for a security boundary. For example, if your company has a separate support group for Windows and Linux, each group can create its own data center.

A *vApp* is a logical way to group applications. Let's say you have 10 web servers running as virtual machines. A vApp allows you to manage them as one. For example, you can shut down the application, and that would shut down all 10 web servers.

Distributed switches are used to connect multiple ESXi hosts together so that the hosts can provide the same network to virtual machines. Distributed switches are more flexible than the standard network virtual switch, often referred to as a *vSwitch*. For example, let's say you have 10 ESXi hosts running virtual machines that are communicating on 10 different subnets. With a standard vSwitch, you have to set up all 10 networks on each host. If you make any mistakes, it can cause problems when you move virtual machines around to different ESXi hosts. When you use a distributed switch, you can configure the 10 networks once, and each host is configured consistently.

vCenter Server is a management application for VMware's vSphere virtual environments that can run as an installed Windows application or a virtual machine running as an appliance. vCenter is a data center component, and it is an important one. vCenter is what ties together all the management aspects of the VMware environment.

A *template* is used to deploy virtual machines. A template is basically a virtual machine configured with an installation of an operating system that you can use to roll out many new virtual machines. You have different templates for different operating systems and

configurations. For example, say you have a Linux web server with Apache installed and configured for your organization. You can convert the virtual machine into a template with a mouse click. Then you can just click and deploy new servers, one or a hundred.

Other VMware appliances include solutions such as vRealize Orchestrator and the vSphere Storage Appliance (VSA) that are deployed as a data center component and a virtual appliance.

Physical and Virtual Component Differences

It is easier to understand data center virtualization if you understand data centers in general, even ones not yet virtualized. Data centers can be big or small, but most share the same basic parts. Some virtual hardware components are easier to understand if they have physical counterparts. For example, imagine a network card. You know it plugs into a server and has connections for network cable. Now, imagine a virtual network card. It has the exact same functionality.

Say you have a data center with dozens of racks in rows of servers. Virtualization can convert these rows of racks of servers into just one row of racks. Consolidation not only lets you save money on power and cooling, but it also enables you to buy a smaller data center and save a lot more, or at least have room to grow.

A physical server is basically a system of interconnected hardware devices, rolled up in a neat little package. Examples of hardware devices include CPUs, memory, storage, network ports (embedded or card), and other installed cards. A physical server for a data center is usually a very high-end computer. Of course, servers are expensive and provide redundancy, capacity, and fail-safe solutions built in. A physical server consumes power and gets hot. Each physical server in a data center has an installed operating system with installed applications. When you are talking about the physical computer or server that runs the ESXi hypervisor, that server is often referred to as an ESXi *host*.

A physical server with a hypervisor installed is referred to as a *host*. Typical vendors are HP and Dell. Physical servers have Intel or AMD processors, memory, network interface cards, and storage.

Routers and switches are hardware devices that provide network packet routing between all of your connected devices. You are using a router when you get on the Internet. A data center can have many routers and switches. Routers and switches also consume power and get hot. Most data centers have some form of cooling to help with the excessive heat generated by all of these devices. With VMware, you can leverage virtualized routers and switches as well.

Shared storage can take many forms. One of the most common in enterprise data centers is fiber attached storage. Shared storage can also be provided by network-attached storage (NAS) devices, and even Network File System (NFS) network volumes. Shared storage is essential for getting the benefits from some virtualization techniques. The hypervisor abstracts storage

from the underlying virtual machine, which allows many types of storage devices to be used with the VMware ESXi hypervisor.

Many kinds of hardware devices can be represented as software in VMware. Hardware devices include network interface cards, hard drives, and CPUs. Hardware devices also can include the physical server as well as routers and switches.

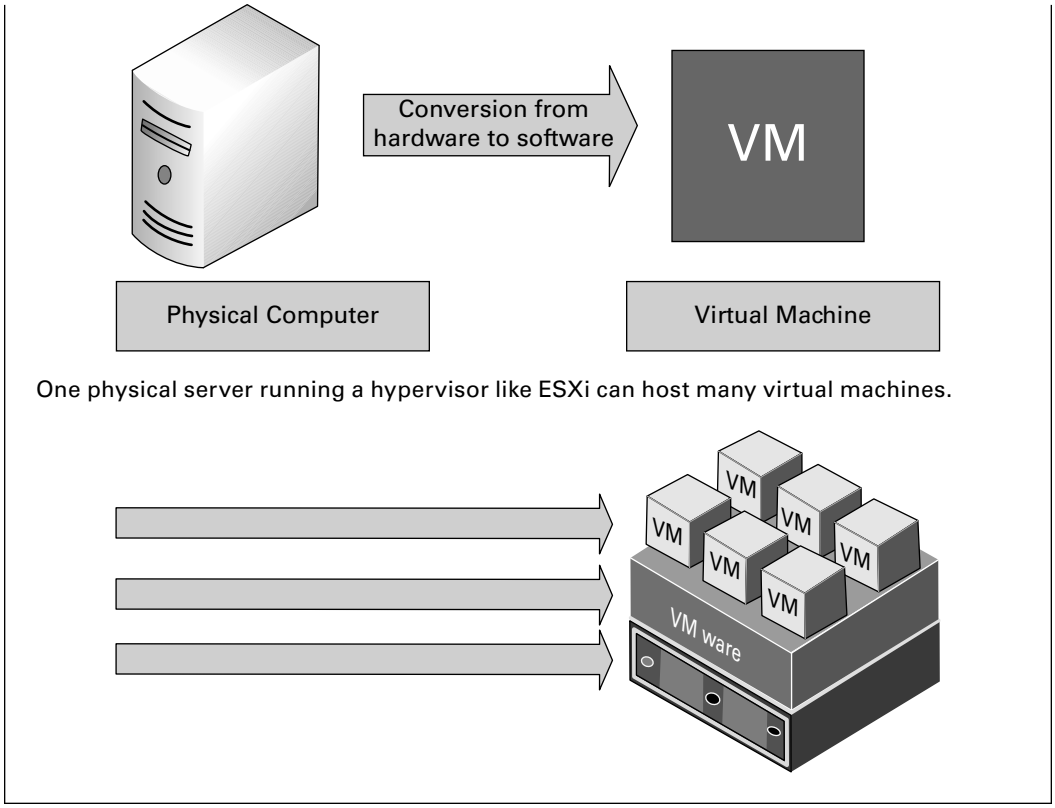
Before virtualization, some companies would load up multiple applications onto each server in order to leverage the existing hardware investment. For example, let's say you have a file server providing data storage to users on your corporate network. However, the server is usually idle and uses only 10 percent of its hardware resources. Now you are asked to install a web server that will have a few demands on the resources. Do you buy a new server to host the web server? You may be tempted to just install the new application on the existing file server to save some money. Many companies did this and experienced problems when one application blew up and took out all applications installed on the same server. Other companies' IT departments knew about the risk of installing many applications on each server. They would just buy another server when a new application was needed. These companies did not experience the problem of one application taking down another because it was installed on the same hardware. However, the hardware costs for these IT departments increased dramatically because of the additional servers they needed to buy. More servers equal more money spent on power and cooling.

If only there were a way to install applications on a server and not have the vulnerability of one application taking down another. This is exactly what virtualization does! You can install a separate operating system to host each application without increasing the number of physical servers you need. This addresses the problem that companies had with having to buy a new physical server every time a new application was rolled out. It also addresses the problem of putting multiple applications on the same physical server.

Virtualization abstracts the operating system and applications from the underlying physical hardware. This abstraction is done by the ESXi hypervisor, which provides everything the physical server provides, but does it in software. The hypervisor is basically a traffic cop that gives each virtual machine access to the hardware when needed. It effectively isolates each virtual machine and allows the underlying hardware to be shared. Since each virtual machine is isolated, one virtual machine will not cause a problem to other virtual machines on the same host.

How Physical to Virtual Machine Conversion Works

Virtualization converts hardware devices into software resources. The virtual machine includes all of the hardware that existed on the physical computer that was virtualized. A VMware program called VMware vCenter Converter does the work of creating a virtual machine based on a physical server.



One physical server running a hypervisor like ESXi can host many virtual machines.

After virtualization, one physical computer or ESXi host can host many virtual machines. This is the magic of virtualization. You can now consolidate many physical servers into one. Consolidation is a big deal. Fewer servers means less power used, and less cooling required, which means the potential for massive cost savings. This is the basic reason companies of all sizes are being drawn to virtualization and VMware's solutions. The cheaper your IT is, the more competitive your company can be.

This section provided a basic core understanding of physical and virtual hardware devices. You should know the difference between physical and virtual servers and know that virtualization is the process of converting hardware devices into software resources. You already have a sense of some of the benefits of virtualization, but next we will discuss those in more detail.

Benefits of Using Virtualization

This section covers the benefits of virtualization. We will start by listing some of the biggest challenges many data centers face and then describe how virtualization software mitigates those challenges.

Imagine you are responsible for a large data center. You have over a thousand servers, and each one consumes a hefty amount of power. Each server generates a lot of heat, and heat is bad for server health. A large data center like this would have many switches, routers, and storage devices that also generate heat. This makes cooling the data center critical.

These are the most common challenges:

- Power usage
- Cooling
- Server cost (capital budget)
- Management of physical servers (operational budget)

Power, cooling, and server cost challenges are addressed by consolidation. Consolidation means fewer physical servers. Fewer physical servers directly relates to how much power is used, how much heat is generated, and how much is spent on hardware. The hypervisor makes consolidation a possibility.

Consolidation is one of the biggest benefits of VMware solutions and is leveraged for large cost savings and flexibility. Through consolidation, you save money not only on power and cooling, but also on data center real estate. Data center real estate is a large expense for most companies, and the server sprawl of the '90s left many data centers cramped.

Managing physical computers is easy when you have only one or two. What if you have a hundred? If you have many servers, they may be different makes and models. Managing a lot of servers is no easy task. And when you need to upgrade the hardware on an application server, typically you will have an outage as you reinstall the application on the new server. Now, imagine you still have a hundred servers, but the hardware has been virtualized. Every server can have the same drivers and configuration more easily. And upgrading the hardware can be done with no downtime to the application server. This is a big deal when the application is a critical one!

One other piece of virtualization software that addresses both power usage and cooling, and to a lesser extent, server cost, is Distributed Power Management (DPM), which requires a vCenter server to implement. The basic idea of DPM is to dynamically move all virtual machines from an entire ESXi host and to power down that host.

Real World Scenario

Leveraging DPM for Profit

Here is one scenario where a company can save a lot of money by leveraging DPM. Let's say you have 1,000 virtual application servers that are very busy during the day running an important application. These virtual machines are hosted on 50 ESXi hosts. In the evening, these are not used at all. By leveraging Distributed Power Management, vCenter

can move all these virtual machines to two or three hosts and power down the now unused hosts. This can save the company a lot of cooling and power expenses.

With some of the advanced functionality that VMware provides, you can take this one step further. Let's say you have 100 virtual machines running Windows that are needed only during the day. Let's also say you have 100 virtual machines running Linux but need them only at night. You can automatically decommission the Windows servers every day and deploy Linux as needed, and reverse the process in the morning. That way, you can really limit the number of physical servers you need running the hypervisor. The same hypervisor can run Windows during the day and Linux at night. This kind of setup is advanced but possible because of virtualization. Not that you cannot do the same thing without virtualization, but it is much harder to do without it.

There are many benefits of data center virtualization. The most obvious, and the one that usually gets the attention of management, is reduced cost. Here is a list of benefits to start us off:

- Reduced cooling needs
- Reduced power consumption
- Application isolation
- Fast deployment
- High availability
- Distributed Resource Scheduler
- Configuration management
- Automated workflows

Let's break each of these down.

Reduced Power and Cooling A great benefit of virtualization is consolidation. Basically, you have fewer physical servers that are hosts to the virtual machines in the data center. Fewer servers means reduced power and cooling requirements.

Application Isolation Instead of having many applications on a physical computer, after virtualization, each application can have its own operating system and virtual hardware that is isolated from other virtual machines on the same physical host. This isolation provides a separation from other applications and makes for a more robust data center. For example, a web server that crashes will not take down other virtual machines or applications that were installed on the same physical server before the virtualization effort.

Fast Deployment Before virtualization, getting a new server up and running in a typical data center could take weeks. You would have to order the server, wait for shipment, have the server racked, and get networking and storage configured. Then you'd have to install the operating system, install required software such as antivirus programs, and make configuration changes so that all the physical servers had a consistent configuration. After a

data center is virtualized, you can leverage VMware products like vCenter to deploy virtual machines in minutes. The new virtual machines can be completely configured with all required applications installed as well as consistent custom configurations. You use virtual machine templates to realize this benefit.

Using Templates

Templates are used to deploy virtual machines, not physical hosts with a hypervisor like ESXi! A template is a file on the VMware datastore, so deploying a virtual machine from a template requires a file copy to a new datastore location.

High Availability High availability—often simply referred to as HA—is a fantastic benefit of virtualization that most virtual data centers could not live without. High availability is a service that runs on each physical ESXi host in a cluster, to monitor every other ESXi host in that cluster. If a single ESXi host in a cluster fails, the other hosts in the cluster realize the failure and automatically re-register the virtual machines to other ESXi hosts and then power the virtual machines back up.

Before virtualization, a mad scramble would occur when a server failed. Typically, an engineer would have to replace the failed hardware before bringing the server back online. But what if you had to order the new parts? Suddenly, you would have to waste a lot of time waiting on the postal service. Some companies would buy extra servers just for this reason, which raised the cost of the data center. And if the server failed in the middle of the night, you either would not know until the next morning, or you would have to drive into work in the middle of the night and attempt to repair the server with heavy eyelids.

After virtualization, things got much better. By leveraging high availability, a physical host server could crash—in this case, the ESXi host—and all the virtual machines on that ESXi host would automatically be powered back on after re-registering to a new ESXi host in the cluster. The virtual machines on the failed ESXi host would endure a hard reset, but typically they would be up in running in a short amount of time.

High availability also extends to virtual machines and applications running on virtual machines. HA can restart a virtual machine on a different host—with spare capacity—when the ESXi host it resided on crashes. HA can restart a virtual machine on the same host when the virtual machine's operating system crashes. In addition, HA—with VMware's vFabric Hyperic and vSphere App HA virtual appliances installed—can restart an application service when an issue is detected. HA protects against host failure, virtual machine operating system crashes, and application crashes.

High availability is amazing, and this is one of the first things new VMware deployments can leverage. However, when an ESXi server fails and HA kicks in, the virtual machines on the failed host experience a power outage before other hosts take action and bring the virtual machines back online.

Distributed Resource Scheduler (DRS) The Distributed Resource Scheduler (DRS) does a good job of spreading workloads across a defined cluster. Some virtual machines use a lot of memory, others use a lot of CPU resources, and it can be a difficult job to spread these uneven loads across multiple physical ESXi hosts. DRS can do this for you, and it can do it on the fly as resource needs change for virtual machines. This is a great benefit.

Configuration Management When you have hundreds or thousands of servers, maintaining a consistent configuration can be a huge problem. Configuration management tools like vRealize Operations (formerly called VMware Operations Manager) take care of configuration and do a lot more as well. vRealize Operations enables policy-based automation for configuration and security hardening as well as capacity management, application-aware infrastructure management, and performance management.

Automated Workflows One of the benefits of data center virtualization is scalability. You can use automated workflows to enable VMware to handle a large number of servers. One example is the routine patching of servers. If your company has five web servers handling all of your traffic and you want to update them, you would log into vSphere and snapshot a server before installing the update. You would do each server in turn. But what if you had hundreds of servers? If you use vSphere to do something, you can do the same thing with a workflow. And, if you need to do that "something" to hundreds of virtual machines, it only makes sense to create a workflow to automate it and share it with everyone that needs it. That way, that "something" is done consistently and correctly every time.

Deploying workflows in vSphere uses vRealize Orchestrator. This is a free virtual app that comes with vCenter. Plug-ins for Orchestrator allow you to control many other aspects of your environment. Automated workflows is an advanced topic that is probably not covered on the exam, but it is an interesting feature.

This section talked about the benefits of data center virtualization and hinted at what you can expect, and plan for, when deploying virtualization. Next we will discuss some online tools you can use to further your knowledge about data center virtualization.

Online Tools

This section presents three valuable online tools that are available to you for expanding your knowledge of VMware products. You can use just this book for the test, but you are encouraged to check these out as well. It is always better to overprepare. Future chapters will let you know about additional online resources that can help you study for your test.

The VMware Certified Associate test blueprint calls out three resources for this chapter:

- VMware vSphere Basics Guide
- Virtualization Basics
- VMware Virtualization Toolkit

The VMware vSphere Basics Guide is on VMware's website:

```
https://pubs.vmware.com/vsphere-50/topic/com.vmware.ICbase/PDF/vsphere-esxi-vcenter-server-50-basics-guide.pdf
```

A quick Google search for *VMware vSphere Basics Guide* may be an easier way to find this online. This guide covers exactly what you think it would: basic information on vSphere that will likely be covered on the exam. If you are just starting to get into virtualization, this is a good place to start.

Virtualization Basics is an online HTML guide:

```
https://www.vmware.com/virtualization/virtualization-basics/what-is-virtualization.html
```

This guide provides a good overview of virtualization. If you have had exposure to VMware, this resource will make a lot of sense. It offers a good general overview of the topic.

The VMware Virtualization Toolkit provides a lot of information that can be useful when you are just getting into the virtualization game. You do have to register in order to download the toolkit; visit `www.vmware.com/virtualization101_register`. After registering, you will be presented with a web page with links to download white papers, watch videos, read review guides, download a 60-day evaluation of the software, and use a decent online TCO/ROI (total cost of ownership/return on investment) calculator.

The VMware site provides many more resources; these are just a few of the basics. In fact, a section in the appendix will discuss in detail very good online resources to greatly expand your understanding of VMware products.

Summary

This chapter presented a core understanding of data center virtualization and the challenges that it addresses. We talked about how to identify physical and virtual hardware devices. We discussed some of the benefits of data center virtualization and a few online tools.

We started with the basics of data center virtualization. We discussed the physical hardware devices that exist in your data center, such as servers and network switches. We also discussed the power and cooling challenges that physical hardware creates, in addition to capital expenses and management costs. We noted that consolidation goes a long way toward meeting these challenges. Consolidation is the big concept here; one of the biggest advantages is that consolidation is made possible by the VMware hypervisor (ESXi). We also showed that management costs can be addressed in different ways. Consolidation, rapid deployment, high availability, and increased utilization all reduce management costs.

We discussed the benefits of data center virtualization on a deeper level and why server consolidation is such a big deal. You learned that power savings and lower cooling costs as well as capital expenses and management costs are more controllable after virtualization. Finally, we took a look at several online resources that would be beneficial to review for the subjects in this chapter. These valuable resources will help with basic understanding as well as more advanced topics covered later in this book.

Exam Essentials

Be able to explain what data center virtualization is. Data center virtualization is the conversion of physical hardware devices into software resources. The hypervisor (ESXi) talks directly to the physical hardware, presents virtual copies of hardware to virtual machines, and isolates virtual machines from each other.

Differentiate physical and virtual data center components. Virtual data center components are software, servers, routers, and switches that can be virtual. Physical data center components are those you can touch, like physical servers, physical switches, and physical routers.

Identify data center virtualization benefits. Consolidation is one of the biggest benefits of virtualization and means fewer servers, less power, and less cooling are needed. After virtualization, automation is more flexible, management costs are lower, and capital expenditures are lower.

Review Questions

You can find the answers in Appendix A.

1. What is an advantage of data center virtualization?
   - **A.** Less power is consumed.
   - **B.** Fewer physical servers are needed.
   - **C.** It saves money on cooling.
   - **D.** All of the above.
2. What is the best definition of *data center virtualization*?
   - **A.** Conversion of hardware devices into software resources
   - **B.** Management of all servers in the enterprise
   - **C.** Storage vMotion
   - **D.** Existence of vCenter Server
3. How many virtual machines can a physical ESXi host support?
   - **A.** 1
   - **B.** 10 times the number of processors
   - **C.** 100
   - **D.** Many; it depends on the resources provided and needed.
4. What is a hypervisor?
   - **A.** vCenter Server
   - **B.** vRealize Orchestrator
   - **C.** A resource traffic cop
   - **D.** Virtual storage
5. What is the biggest advantage of virtualization?
   - **A.** Using vCenter Server
   - **B.** Load balancing
   - **C.** Server consolidation
   - **D.** Leveraging virtual devices
6. A dozen virtual machines are running on one physical ESXi host after virtualization of your data center. Are the virtual machines aware of each other on this one physical host?
   - **A.** They are aware of each other.
   - **B.** They are aware of each other and can communicate directly.
   - **C.** They are aware of each other and can communicate directly and indirectly.
   - **D.** They are not aware of each other.

7. What is DPM?
   A. Deployment Performance Monitoring
   B. Development Project Management
   C. Distributed Performance Management
   D. Distributed Power Management

8. The physical server with ESXi installed is often referred to as what?
   A. Virtual machine
   B. Host
   C. Server
   D. All of the above

9. VMware supports virtualized versions of what physical devices?
   A. Servers
   B. Servers and routers
   C. Servers, routers, and switches
   D. Servers, routers, switches, and network interface cards

10. A virtual machine running Windows 2012 gets a blue screen of death. What will happen to the other virtual machines on the same ESXi host?
    A. The other virtual machines will be shut down gracefully.
    B. The other virtual machines will be hard-powered off.
    C. The other virtual machines will experience a momentary suspension of computing resources.
    D. Nothing.

11. You can expect to save money on what as a direct result of data center virtualization? (Choose two.)
    A. Management costs
    B. Capital expenses
    C. Windows licenses
    D. Linux licenses

12. Which is the best term to describe reducing the number of physical devices in the data center by virtualization?
    A. Disaster recovery
    B. Archiving
    C. Automation
    D. Consolidation

13. What are the most common challenges addressed by virtualization?

- **A.** Cooling, consolidation, and conversion
- **B.** Power usage, cooling, and rack space
- **C.** Power usage, cooling, and server cost
- **D.** Power usage, cooling, server cost, and virtual machine management

14. Which VMware component is the hypervisor?

- **A.** ESXi
- **B.** vCenter
- **C.** NSX
- **D.** Distributed Switch

15. What does the term *consolidation* mean in VMware context?

- **A.** Converting physical devices to software resources
- **B.** Storage virtualization
- **C.** Having fewer physical servers
- **D.** Capital budget cost savings

16. Which one of these is a benefit of data center virtualization?

- **A.** More servers
- **B.** Process speed
- **C.** Generated heat
- **D.** Fast server deployment

17. Which of these is a physical hardware device?

- **A.** Memory
- **B.** CPU
- **C.** Network interface card
- **D.** All of the above

18. What is the resource traffic cop?

- **A.** vCenter
- **B.** Storage
- **C.** Physical CPUs
- **D.** Hypervisor

19. Which of these are parts of a virtual machine? (Choose three.)

- **A.** Virtualized operating system
- **B.** Virtualized applications
- **C.** Virtualized physical hardware
- **D.** Virtual switch

20. Which of the following VMware technologies provides virtual copies of server hardware to virtual machines?

A. vCenter

B. Hypervisor

C. Virtual switch

D. Virtual distributed switch