Learning Hyper-V

Learning Hyper-V will help you understand the core components of Hyper-V and provide you with the knowledge you need in order to become proficient in it. You'll be able to fully understand the components of its architecture, deployment options, and even licensing, so you'll be able to work on projects from conception to implementation.

Following that, you'll see how to manage the core components including network and storage. New and updated features such as Live Migration, Hyper-V Replica, and High Availability will be covered in detail and you'll get a full understanding of virtual machine operation and how to achieve the most from it.

Additionally, important scenarios will be covered such as Disaster Recovery, VDI, and even the controversial Active Directory virtualization so you will be one step ahead in the market.

Who this book is written for

This book focuses on readers starting their journey with Hyper-V, and assumes they have minimal or no knowledge of virtualization.

What you will learn from this book

- Understand Hyper-V architecture and components
- Learn multiple options to perform host deployment
- Manage and configure networking and storage for Hyper-V
- Deploy and manage your virtual machine
- Understand the High Availability and Disaster Recovery options and configurations
- Manage a VDI environment with Hyper-V
- Master the PowerShell commands to manage virtualization environments
- Become proficient with Live Migration and Hyper-V Replica configurations

In this package, you will find:

- The author biography
- A preview chapter from the book, Chapter 3 'Licensing a Virtualization Environment with Hyper-V'
- A synopsis of the book’s content
- More information on Learning Hyper-V

About the Author

Vinícius R. Apolinário is a professional with more than 13 years of experience in information technology. He has worked with Microsoft and in other industries, managing servers and environments of small, medium, and large companies. With a strong background in managing servers for directory services and client infrastructure, he has focused on virtualization and data center management in recent years.

Vinicius is a Microsoft Certified Trainer and system engineer on Windows Server 2012 and Private Cloud. Besides this, he holds a cloud computing certification from EXIN and teaches this technology. He also holds a certification of Extension Course in Product Marketing Manager by Fundação Getúlio Vargas (FGV). His last achievement was becoming a VMware Certified Associate and a VMware Certified Professional for data center virtualization.

Currently, Vinicius works for Microsoft in Brazil as a technical evangelist, presenting new technologies on Windows Server, Hyper-V, System Center, and Microsoft Azure to customers. Prior to this book, he reviewed *Hyper-V Cookbook* and *Hyper-V Cluster Design*. 
Learning Hyper-V

Hyper-V is gaining market share over its competitors, and is already the leader in some markets. With the release of Windows Server 2012, Hyper-V is positioned not only as a low cost alternative, but also as a featured virtualization platform. Therefore, every day, an increasing number of administrators take the first step to acquiring Microsoft virtualization technologies. As a step-by-step guide, this book will take you through a journey that involves learning about the Hyper-V platform from scratch. This will prepare you to become a more versatile Hyper-V admin.

What This Book Covers

Chapter 1, Getting Started with Hyper-V Architecture and Components, covers the Hyper-V architecture and takes a deep dive into how its basic components, such as the processor and memory, can influence a host's performance and utilization.

Chapter 2, Deploying Hyper-V Hosts, covers multiple Hyper-V deployment options and provides you with the pros and cons of each option.

Chapter 3, Licensing a Virtualization Environment with Hyper-V, provides an overview of licensing a virtualization environment with Hyper-V for Windows Server, Windows Client, and Linux VMs. You will also be given tips and tricks regarding licensing Microsoft virtualization environments.

Chapter 4, Managing Networking, focuses on networking configuration for hosts and Virtual Machines (VMs), allowing you to understand how to configure physical and virtual networks for better performance.

Chapter 5, Managing Storage, covers storage and its influence on a host and VM performance, and presents you with techniques to optimize storage.

Chapter 6, Virtual Machines and Virtual Machine Templates, covers multiple components of a VM and its templates to optimize creation of a VM with Hyper-V.

Chapter 7, Implementing High Availability, provides an overview of Microsoft failover clusters that are used to support Hyper-V with High Availability (HA).

Chapter 8, Implementing Live Migration and Replica, covers how to prepare a virtualization environment for scheduled maintenance and Site Disaster Recovery.
Chapter 9, *Virtualizing Active Directory Domain Controllers*, covers the best practices used to virtualize Domain Controllers, avoid replication problems, and get around configuration mistakes.

Chapter 10, *Implementing a Virtual Desktop Infrastructure*, covers the basics involved in Virtual Desktop Infrastructure (VDI) and Remote Desktop Services (RDS), and how Hyper-V can support them.

Chapter 11, *Protecting Your Virtualization Environment*, gives an overview of the protection used for hosts and VMs in a virtualized environment. The chapter will also provide an overview of other tools that are used for backup and restore.
Licensing a virtualization environment has never been an easy task, either because of the Microsoft licensing model, or because of the applications running on a virtual environment. But when virtualization became popular, and more and more companies started to virtualize their workloads, vendors started facilitating the licensing model for virtualization. Microsoft followed this trend, and in the Windows Server 2012, Microsoft changed the licensing model for Windows Server completely, directly impacting virtualization.

In this chapter we will cover the following topics:

- Virtualization licensing in the early days of Windows Server 2008 and 2008 R2
- Virtualization licensing on Windows Server 2012 and 2012 R2
- Benefits of Software Assurance on virtualization
- Hyper-V Replica impact on virtualization
- Licensing Linux VMs on Hyper-V
- Licensing models for Virtual Desktop Infrastructure (VDI)

Before we go through any details on licensing itself, it is important to understand some of the terms that will be used throughout this chapter:

<table>
<thead>
<tr>
<th>Terms</th>
<th>Description</th>
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<tbody>
<tr>
<td>Processor</td>
<td>The physical processor installed on the host machine. Microsoft does not count cores or hyper threads from a licensing perspective.</td>
</tr>
<tr>
<td>OSE</td>
<td>Operating System Environment. OSE is the environment where you install an OS: virtual (guest OS) or physical.</td>
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</tbody>
</table>
Licensing a Virtualization Environment with Hyper-V

<table>
<thead>
<tr>
<th>Terms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypervisor</td>
<td>In this context, Hypervisor is the software installed on the host machine. It may be the OS itself or a software running on the OS installed on the host machine.</td>
</tr>
<tr>
<td>Software Assurance (SA)</td>
<td>SA is an SKU available on some Microsoft Contracts that have multiple benefits. Some of these benefits will influence the final license of the virtualization environment.</td>
</tr>
</tbody>
</table>

If you're new to Hyper-V, you probably don't know it, but licensing a virtualization environment with Hyper-V prior to Windows Server 2012 was a bit confusing. But one thing remains the same: in a virtualization environment, you do not license the host; you have to license the VM. To begin the conversation, let's understand how licensing used to work before Windows Server 2012.

**Licensing a virtual environment prior to Windows Server 2012**

It is important to understand how licensing used to work before Windows Server 2012, as understanding it will show how easy it is today to license your environment. In addition, if you come to manage a legacy environment one day, you will be able to verify if the licensing for this environment is correct.

One aspect of Windows Server 2008 and 2008 R2 that is different from Windows Server 2012 and 2012 R2 is that 2008 and 2008 R2 had more editions available for purchase. At that time, you were able to license the following editions:

- Standard Edition
- Enterprise Edition
- Datacenter Edition

There are actually other editions for 2008 and 2008 R2, but they focus on specific scenarios such as Small Business Server Edition and Foundation Edition, and will not be covered here.

One important aspect of Windows Server 2008 and 2008 R2 is that these editions had differences between them, not only from the virtualization licensing perspective, but also on the features and hardware capacity. For example, Failover Clustering was only available for Enterprise and Datacenter Editions. Standard had support for only 32 GB of RAM. Datacenter Edition did not have the Remote Desktop role, but, on the other hand, was the one that supported the highest hardware configuration. In short, to purchase the correct edition, you had to check what feature and hardware configuration matched the needs of your company.
After understanding the minimum requirements regarding features and hardware support, you had to check if the given version had the correct number of licenses for the VMs running in your environment, but there is a trick difference in the way you apply the license on the host. Standard and Enterprise were applied considering the physical server, the box on which it was licensed. Datacenter, on the other hand, was applied considering the number of physical processors on the host.

**Standard and Enterprise Editions of Windows Server 2008 and 2008 R2**

As the Standard and Enterprise Editions were applied for the host, the box where you’re running the Hypervisor, you did not have to count the processors. It was a facilitator for small and medium companies that run a few number of VMs.

The difference between the Standard and Enterprise Editions is that Standard licensed only one instance of a Windows Server VM, and Enterprise licensed up to four Windows Server VMs.

As you can see, Standard was not exactly focused on virtualization. But, in some cases, is still worth it. Imagine the following environment: you have a virtualization server and you run only two Windows Server VMs. In this case, you were able to buy two licenses of Windows Server Standard which allowed you to virtualize those two machines.

However, there are other caveats in this model. The Standard Edition will give you actually two OSE instances, one for the VM and one for the host machine. It means that you can install the same license two times, but keep in mind that the host machine can run only the virtualization stack and nothing more. If you install any other software on the host OS, you lose the right to run a VM with the same license. In the previous example, if you have two licenses of the Windows Server Standard Edition, and you install another software on the host, you'll be able to license only one VM OSE and the host OSE. You could buy another license of the Standard Edition, but then you get to a moment where the Enterprise Edition is better.

The Enterprise Edition was the so-called entry level for virtualization. This is because the Enterprise Edition allowed you to run up to four OSEs, plus the host OSE. It means that you can have four VMs with the Windows Server and still install Windows Server on the Host, with the same concept of using it for virtualization purposes only. In fact, in most cases, acquiring an Enterprise Edition had more benefits than Standard, because, even if you don't have more than two VMs, you are better prepared for scaling in the future.
To summarize the Standard and Enterprise licensing on the Windows Server 2008 and 2008 R2, Standard will allow you to license only one VM OSE and the host OSE. Enterprise would allow you to run up to four VM OSEs and the host OSE.

**Datacenter Edition of Windows Server 2008 and 2008 R2**

Different from Standard and Enterprise, the Datacenter Edition on Windows Server 2008 and 2008 R2 was the only one licensed per processor. Each license of the Datacenter Edition would license up to two processors. However, the real benefit of the Datacenter Edition was that it would license an unlimited number of Windows Server VMs.

The Datacenter Edition was an option for the companies that were running virtual environments with high consolidation, on host servers. With that, you only had to account for the number of processors per server and verify the number of licenses that each host required. If a virtualization server had four processors, you had to buy two licenses, but, with that, you were able to run as many VMs as the host was able to run.

Although you can run as many VMs you want per host, Hyper-V on Windows Server 2008 R2 supports 384 VMs per host.

That model was perfect for companies that did not want to worry about licensing, as all you had to do was account for the number of processors per host and licensing these processors.

With that, it was clear to customers that licensing a virtualization environment was not an easy task. It required some help from the licensing partner, and, before acquiring the Windows Server License, it was necessary to verify multiple details like: which features are available on each edition? Which of these features does the company really need? How many VMs is the company going to run on each host? Is it better to license per host or per processor? To summarize the licensing perspective, let's have a look at the following table:

<table>
<thead>
<tr>
<th>Edition</th>
<th>Licensed by</th>
<th>Processors covered</th>
<th>Editions allowed to install on VMs</th>
<th>Number of VMs licensed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Host</td>
<td>-</td>
<td>Standard only</td>
<td>1</td>
</tr>
<tr>
<td>Enterprise</td>
<td>Host</td>
<td>-</td>
<td>Standard and Enterprise</td>
<td>2</td>
</tr>
<tr>
<td>Datacenter</td>
<td>Processor</td>
<td>2</td>
<td>Standard, Enterprise and Datacenter</td>
<td>Unlimited</td>
</tr>
</tbody>
</table>
With the release of the Windows Server 2012, and the new version of Hyper-V, it was clear that virtualization was a point of no return. With that, Microsoft radically changed its licensing model on Windows Server 2012 and 2012 R2 to make it easy for the customers to license their environment.

**Licensing a virtual environment with Windows Server 2012 and 2012 R2**

With Windows Server 2012 and 2012 R2, Microsoft decided to focus its licensing all over virtualization. Of course, you can choose not to virtualize, but there are benefits in the virtual environments.

The first big change was the retirement of the Enterprise Edition, leaving the Standard and Datacenter Editions as the available choices. Again, there are other options for small businesses, but they are not the focus here. With only two options available, customers have now a simple scenario to choose.

The other big change is that the Standard and Datacenter Editions are exactly the same regarding technical features. It means that all features are available on both editions, such as cluster, RDS, and so on. Also, both editions have the same support for hardware. In conclusion, the only difference (apart from licensing) between the Standard and Datacenter Editions is the Windows Server logo.

The question you might have now is: if both versions are exactly the same, why will a customer choose one over the other? I'm glad you asked.

The most impacting change on the Windows Server 2012 and 2012 R2, besides the number of editions available, is that Standard will license up to two VM OSEs, and Datacenter will license an unlimited number of VM OSEs. Moreover, both editions are licensed by the processor, covering up to two processors for each license, which facilitates the accounting of the servers in the environment.

Basically, all you have to ask is: is my company going to have a virtual or a physical environment? If the answer is physical, you can choose to use the Standard Edition as it will have all the features and will license the server to run with all the features and scalability available on the Windows Server 2012 and 2012 R2. If the answer is virtual, then the best choice is the Datacenter Edition. This is because all you have to do is check the number of processors on the hosts and buy the necessary licenses for them. Having a Datacenter license on the host allows you to scale without problems with a number of VMs. You just have to make sure that the number of licenses covers the number of processors. Let's take a look at some scenarios.
Virtualizing with Standard or Datacenter Editions

The Standard Edition, as the Datacenter, will cover up to two processors per server. In the case where you have a virtualization server with only one processor, you can associate the Standard license to this server. In the future, you can add a new processor to the server without acquiring a new license because the Standard license associated with the server is already in place. If you add three new processors, the server now has four processors and you have to buy one new Standard license for this server. On the other hand, with only one license, you can have two VMs with the licensed Windows Server. With two Standard licenses, you can have four VMs with the Windows Server.

Keep in mind that for licensing the Windows Server, Microsoft count processors as sockets and cores are not considered. In case you have a processor with one socket and four cores, it is still only one processor. You can have two processors with four cores each, and it will still be accounted as two processors.

In Chapter 2, Deploying Hyper-V Hosts, we discussed that you have the option of installing the Hyper-V Server as the OS for the host, but in some cases, you still need Windows Server. The point that causes more confusion is when you have a Windows Server installed on the host. That's because with Windows Server and all its available features, some companies end up using the host server for additional purposes, like File Server, DHCP, and others. This is not recommended, as the Windows Server OSE installed on the host machine should be dedicated to virtualization if you want to make use of the two OSEs available for the VMs.

Another example of licensing a server is when you have a host with two processors, which requires only one license, but you have six VMs running Windows Server. In this case, although the processor count requires only one license, you actually need six licenses because of the VMs.

As the Standard and Datacenter Editions have the same technical limits, you can simply associate Standard licenses to a host to comply with the number of VMs running Windows Server. However, as you can imagine, at some point there is no benefit in using the Standard Edition. As we are not covering the actual price of each license, it's recommended to verify if your company has any valid contract and what the prices is of the Standard and the Datacenter Editions. This price may vary because of the Volume Licensing benefits that each company has. Nevertheless, at some point, when you reach an X number of VMs you will find that the Datacenter Edition is cheaper than the Standard.
That's because, as mentioned earlier, the Datacenter Edition requires you to just check the number of processors of the host. For example, if a host has eight processors, you will need four licenses of the Datacenter Edition, but you can run as many VMs as the host is able to run.

Hyper-V on the Windows Server 2012 and 2012 R2 supports up to 1024 VMs per host.

At this point, I believe you are able to see how easy licensing a virtual environment with Hyper-V and Windows Server VMs is. To summarize:

- Windows Server 2012 and 2012 R2 have two editions for virtual environments: Standard and Datacenter
- Standard and Datacenter have the same features available and support the same hardware limits
- Standard covers up to two processors and up to two VMs with Windows Server, while Datacenter covers up to two processors with no limits of VMs running Windows Server

One important aspect of both the editions is that the edition you purchase will allow you to run the edition itself and the edition lower. For example, if you buy the Standard Edition, you can run the Standard Edition on the VMs, but if you buy the Datacenter Edition, you can run the Datacenter or the Standard Editions on the VMs. This is a general rule that comes since Windows Server 2008 and 2008 R2 when it would make a difference to run a different edition. On Windows Server 2012, it is still valid but makes no effect. Let's have a look at the following table that summarizes all this:

<table>
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<tr>
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<tr>
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<td>Processor</td>
<td>2</td>
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<td>2</td>
</tr>
<tr>
<td>Datacenter</td>
<td>Processor</td>
<td>2</td>
<td>Standard and Datacenter</td>
<td>Unlimited</td>
</tr>
</tbody>
</table>

As expected, Datacenter is always the easy way, and also the recommended way to license a virtual environment with Windows Server. That's because the Standard Edition can bring many questions. Let's have a look at some of them.
Specific scenarios with Standard Edition

The Standard Edition can be used for virtualization without any restrictions from the technical perspective, but on the licensing side there are some caveats that you should know about before going to production. The first question you might have with what was said earlier is: if the Standard Edition allows only two VMs per host, and I'm able to move the VMs between them, what about the licensing in this scenario? To understand this point, take a look at the following scenario:

In the scenario depicted in the preceding diagram, Host 01 has four processors and four VMs running Windows Server. You then associate two licenses of the Windows Server 2012 R2 Standard Edition. You're all set, but after some time, your company acquires a new server named Host 02. This server also has four processors. You install the Hyper-V Server on this host. Right now, there is absolutely no need to associate a license to this host, but when you move one VM from Host 01 to Host 02, you have to license Host 02 as well. In this case, you will need two licenses of the Windows Server 2012 R2 Standard Edition, because of the processors. This is the case where both servers are working together. It is valid for a cluster or a standalone environment. However, there is another case. See the following figure:

In the preceding case, your company bought Host 02 to replace Host 01, either because Host 01 presented a hardware failure or because it is obsolete. In both cases, you don't have to buy a new license of the Windows Server 2012 R2 Standard Edition. In this case you can re-associate the licenses which you already have to this new host. Keep in mind that this is valid only if you retire Host 01 and don't use it again.
This case is valid only if the license you bought to Host 01 is not an OEM license. An OEM license is cheaper than the regular licenses but OEM license locks the license to the host and you cannot re-associate that license to another host.

At this point, you understand the basic concepts of licensing a virtual environment with Hyper-V for Windows Server. Notice how I discuss Windows Server all the time. This is important for two other scenarios that you might have imagined already: what about Windows Client and other non-Microsoft OS?

Before we go into that, there is one missing piece on the host that we already mentioned in Chapter 2, Deploying Hyper-V Hosts, but now we can go into details.

Virtualization host licensing and its impacts

This is the most common question: if I'm licensing the Windows Server to run VMs with Windows Server, do I have to install the same Windows Server on the host?

The simple answer is no. As already discussed in Chapter 2, Deploying Hyper-V Hosts, you should consider the option that best fits your company's needs. Besides technical aspects, there is one important licensing point to consider.

As you know, you should always consider the Hyper-V Server as the first option for your virtualization host. However, Hyper-V Server is a free OS. It still includes all the Hyper-V features, but is different from the Windows Server as it does not include any Windows Server usage rights. Let's see an example.

Following what you learned so far, you checked all the prerequisites for your virtualization host and you concluded that the Hyper-V Server is a suitable option for your company. You then install the Hyper-V Server on a host with two processors. On the other hand, the Hyper-V Server does not include any virtualization rights for the Windows Server.

In the first scenario, your company wants to run four VMs with the Windows Server 2012 R2. In this case, you can run the Hyper-V Server on the host and associate the necessary licenses to the host to run the number of VMs you wish; in this case, two licenses of the Windows Server Standard or one license of the Windows Server Datacenter.
See that you're not installing the Windows Server that you have the license for on the host. You're associating these licenses to this host. This association allows you to cover the processors and run these Windows Server OSEs on the VMs. You still have the ability to install the Windows Server on the host, in case the Hyper-V Server does not meet your needs.

Right now, you're probably wondering: if the Windows Server license is just an association, and I'm able to install the Hyper-V Server on the host, what about other Hypervisors?

**Licensing Windows Server VMs with other Hypervisors**

Let's have a look at another scenario: you have a virtualization host, but for any given reason, you decide not to use Hyper-V as your Hypervisor, or you have a mix of hosts with different Hypervisors. For the hosts using other Hypervisors, the licensing rule remains the same.

You'll have to associate the Windows Server license to a host to cover the processors and the VMs running Windows Server OSEs. Let's say that you have a host with four processors and six VMs running Windows Server. In this case, you're running any other Hypervisor, like VMware ESX or Citrix XenServer. You still have to associate either three Windows Server Standard licenses or two Windows Server Datacenter licenses to this host.

The only point that you should keep in mind is that these Hypervisors may have their own licensing terms which will not be covered here.

One important and common mistake is that the Windows Server Standard license allows you to have three OSEs in total—two for the VMs and one for the host. In the scenario where you're using another Hypervisor with its own OS on the host, you lose the Windows Server OSE license for the host and you cannot convert it into three Windows Server VMs. This is also true for another scenario.

If you're familiar with VMware ESX, Citrix XenServer, and many other Hypervisors, you know that these Hypervisors have their own OS, and you don't need to install Windows Server on the host. This is true for Type 1 Hypervisors, as seen in Chapter 1, *Getting Started with Hyper-V Architecture and Components*. For Type 2 Hypervisors, on which you'll run the Hypervisor software on top of Windows Server, you need the Windows Server OSE license, the same way you need it when you're installing Windows Server with Hyper-V. Examples of these scenarios include VMware Workstation, Oracle VirtualBox, and many others.
Host licensing with Hyper-V Replica

Hyper-V Replica will be explained in detail in Chapter 8, Implementing Live Migration and Replica, but there is a licensing issue with that technology. Basically, Hyper-V Replica allows you to have a replica of a VM on another Hyper-V Host. This host can be on the same or another site. See the following figure:

One important question about Hyper-V Replica is that the VMs on the Replica Server will always be turned off. As the VMs are turned off, many customers believe it is not necessary to license this environment. The question about this is that, although they are off, these VMs are being changed, as the goal of Hyper-V Replica is to asynchronously update the Replica VMs.

In the preceding scenario, you'll have to license both Host 01 and Host 02. You can even use the Hyper-V Server as the OS for both the hosts, but you have to associate the necessary licenses to both the hosts considering the processors and VMs.

There is, however, a benefit for the customers with a contract with Microsoft. Such customers can include the Software Assurance (SA) in their contracts. An SA has multiple benefits the customers who have a contract for the complete period that the contract is valid for. The most important one is the ability to upgrade from the previous versions to new versions of software. For example, you can automatically upgrade from Windows Server 2012 to 2012 R2 if you have SA enabled in your valid contract. The reason we are explaining all this is because if you have SA enabled in your contract, and the hosts and VMs are licensed with the Windows Server license included in the contract, you don't have to license the Replica Server and Replica VMs. In this case, you would have to license Host 01 only.
This is true for all contracts with SA enabled and the contract is still valid, but there are the following restrictions:

- The VMs on the Replica Server must be turned off all the time, unless for testing, disaster recovery, and patching (patching is not the case in Hyper-V Replica as the VMs are updated from the source VM).
- If Host 01 is a cluster node, and the VM is highly available, the replica VMs cannot be part of the same cluster. It is possible to replicate the VM on another cluster. The other way around is also true. The source VM can be on a standalone host and the Replica VM on a cluster node.
- This benefit is not valid when the contract ends. The company has the option to renew the contract and the SA benefit. If the contract or the SA benefit is not renewed, the company will have to license the Replica Server and the Replica VMs.

Now it is time to take a look at the VMs and the impact of using other operating systems other than Windows Server.

**Hyper-V licensing with Linux VMs**

Licensing VMs with Linux is actually the simplest scenario for Hyper-V. So far, you've seen that, from the licensing perspective, if you have a Windows Server VM, all you have to do is to associate the correct number of Windows Server licenses according to the number of VMs and processors on the host.

If you're running only Linux VMs, you actually don't need any license from Microsoft. The most obvious option is to use the Hyper-V Server that requires no Windows Server licenses.

Let's see an example: you have two virtualization hosts. Host 01 will run four Windows Server VMs and Host 02 will run 04 Linux VMs. Both hosts have four processors. In this case, you will need only two Windows Server licenses for the whole environment, and you will associate these licenses with Host 01 where the Windows Server VMs are. There is a caveat here, however: if you move any Windows Server VM from Host 01 to Host 02, you will have to license Host 02 as well. This is not true the other way: if you move a Linux VM from Host 02 to Host 01, you do not need any additional license to Host 01.
The same rule applies in the case that you have only one host with the Windows Server and Linux VMs. Let's take the same previous example where you have two hosts; Host 02 is where the Linux VM is in maintenance, and you move the Linux VMs to Host 02. In every case, all you have to license are the Windows Server VMs, not the Linux VMs. You can actually create even more Linux VMs, as long as the Windows Server VMs are licensed.

Another interesting point is the re-association. Considering the same example, imagine if Host 01 fails and it is irreversible. You can re-associate the licenses from Host 01 to Host 02, where the Linux VMs resides, and move the Windows Server VMs to Host 02, respecting processors counting.

Keep in mind that all the explanation above is focusing Windows Server licensing on a mixed environment of Windows Server and Linux. Some Linux distributions are not totally free to use and you must verify with the software vendor the licensing terms of each distribution. Those will not be covered here.

As in Chapter 1, Getting Started with Hyper-V Architecture and Components, you should also check which Linux distributions are supported on Hyper-V. You can check it at http://technet.microsoft.com/library/dn531030.aspx.

Now you know how to license your environment for the Windows Server, and even with previous versions of Windows Server, you know how to choose the best option for your host, and you know how using Linux with Hyper-V is easy. Now, let's take a look at Windows Client.

**Windows Client licensing on Hyper-V**

If you are a server person, a data center manager, you’re probably not familiar with Windows Client licensing, although this is not new stuff. Using virtualization to host Windows Client is not as common as hosting Windows Server or Linux VMs. This scenario will be explained in more detail in Chapter 10, Implementing a Virtual Desktop Infrastructure, but, for now, what you need to know is that some companies use the data center processing power to host the users' OS. Instead of using high performance devices for users, they virtualize the Windows Client on the virtualization hosts of the data center and use this processing for the customer’s applications. The users will access these VMs remotely from their devices. However, the licensing of Windows Client is different from Windows Server.
Licensing a Virtualization Environment with Hyper-V

As the licensing for Virtual Desktop Infrastructure (VDI) has not changed much from Windows 7 to Windows 8 and 8.1, we will cover the concepts of VDI for Windows 8 and 8.1 and if necessary point out what has changed.

The main difference between licensing on Windows Server and Windows Client is that on Windows Server, you associate the Windows Server License to the host, respecting the number of processors and the VMs you are running, but you are still associating it to the virtualization host. In the VDI scenario, the license that you use is called Virtual Desktop Access (VDA) and you have to actually license the device used to access the Windows Client VM. That changes everything and let me point it out, as this will be the core of everything in this section:

- The VDA license is accounted for by the devices used to access the Windows Client VM. Having said that, you can create as many VMs with Windows Client that you need to support your environment, and you can also have as many users you want, as long you license all the devices they are going to use with a VDA license.

I'm pretty sure that you have a lot of questions right now, so I'll try to answer them. I believe the first one is "If my company already bought a Windows Client version for the users' machines, do I need to buy the VDA license?" To better answer that, and all other questions, let's see all the scenarios covered by the licensing terms.

**Windows PCs and VDI**

In this case, we are talking about a PC that is running a Windows Client version that is not the RT version. In such a case, the company has the following two options, depending on who is the owner of the device:

- **Scenario 1**: The company owns the Windows PC and has already bought a Windows Client license for it. In this case, the company will provide a VDI infrastructure for the users to access their VMs and the applications within the VMs.

- **Scenario 2**: The user owns the Windows PC and the PC is used at home by the user. This PC will never come to the company, but the user is able to access the VDI infrastructure provided by the company.

The answer for both the given scenarios is Yes. The company will have to associate a VDA license for all the devices accessing the VDI environment.
Despite the fact that we have two scenarios as mentioned, the company has the following three to choose from:

- **Option 1 for Scenario 1**: The company can acquire a VDA license for all the company's PCs. This will allow all Windows PCs to access the VDI environment.

- **Option 2 for Scenario 1**: The company can choose to add the Software Assurance (SA) to the contract. As said before, SA has multiple benefits. One of the benefits of SA is the VDA license for the Windows Clients in the contract.

- **Option 1 for Scenario 2**: The only option in this case is to acquire a VDA license for all the PCs that are going to access the VDI environment.

### Company-owned Windows RT tablets

Some companies are acquiring new devices for the workforce, focusing on production and freedom for the user. When using a tablet, the user can work from anywhere and still be as productive as on a PC. In many cases, as the tablet is not able to perform tasks like a PC, the companies provide the VDI environment to the users.

In this case, we are talking about a Windows RT device accessing the VDI environment, but the company has already provided the user with a company PC and the Windows PC is the primary device. Both the Windows PC and the Windows RT tablet belong to the company.

In this case, the company has the following two options:

- **Option 01**: Assign a VDA license to each Windows RT tablet. This will allow the tablet to access the VDI environment as any other device.

- **Option 02**: Assign SA to the contract. The SA has a new benefit called **Windows RT Companion VDA Rights**. This benefit allows the company to assign a VDA license to the Windows RT tablets for users who have a Windows PC owned by the company and a Windows RT tablet.

There is a caveat here, however: the company must own the Windows RT tablet. If the user owns the tablet, the SA will not apply and the company will have to buy the VDA license for the user's device.

As you can see, the licensing for VDI is very specific for each scenario, and you might be thinking "There are other scenarios not mentioned here. What about them?" These options are new to Windows 8 and 8.1 licensing. Let's explore them.
User devices inside or outside the company network

This is a little bit more challenging. Let's first define what is inside and outside the company network. From the licensing perspective, inside the company is every device accessing the company resources from inside the company firewall. Everything behind the company firewall, or on the public network, is considered outside the company network.

This is important to understand as there are two ways of licensing your environment based on that information. In both scenarios, the user owns the device and will access the VDI environment. Let's take a look at the following scenarios:

- **Scenario 01**: A user owns the device and will access the VDI environment from outside the company network
  
  In this case, there is another benefit from SA called Roaming Use Rights. This is only available when the company has a primary device (Windows PC and Windows Client license) in a contract with SA. This benefit was created for users working out of office, like in a hotel, accessing the VDI environment from their own machines or a kiosk.

  If the company does not have an SA, the only alternative is to acquire the VDA license for every device accessing the VDI environment.

- **Scenario 02**: A user owns the device and will access the VDI environment from inside the company network
  
  This scenario is also known as **Bring Your Own Device (BYOD)**. It is becoming very popular and is the trickiest one. The reason why this is so is because, depending on the type of contract you have, the VDA license is already covered.

According to the **Product User Rights (PUR)**, the document defined by Microsoft stating all the licensing terms, if your company has Select, Enterprise Agreement, Enrollment for Education Solutions, or a School Enrollment contract, and the SA is enabled in the contract for the users' primary device, the company can also acquire a **Companion Subscription License (CSL)**. The CSL allows the user to bring up to four devices (owned by the user), and use it to access the VDI environment.

If the company has any other type of contract, or does not have SA, or even does not acquire the CSL, the company will have to acquire a VDA license for each user owned device that will access the VDI environment.

So far, we've seen how to license the VDI environment for Windows devices, both company or user-owned. The next question is "What about non-Microsoft devices?"
Non-Microsoft smartphone and tablet licensing for VDI

More and more often, we can see that users are using multiple devices to work with, other than their primary PC-smartphones, tablets, and now even smartwatches. From the VDI licensing perspective, every device that was not covered in the earlier sections, and which can access the VDI environment, must have a VDA licensing.

From a technical perspective, the device must have the capability to access the VDI environment, which is a Remote Desktop client, in other words. Today the iOS, Android, and the Windows Phone have the ability to access the VDI environment with clients provided by Microsoft on the AppStore, Google Play, and the Windows Phone Store. There are other non-Microsoft clients for Remote Desktop access, but regardless of the software used to access the VDI environment, a VDA license is required.

For any other question regarding VDA, I highly recommend that you contact your re-seller. You can also check the official documentation at [http://www.microsoft.com/licensing/about-licensing/windows8-1.aspx](http://www.microsoft.com/licensing/about-licensing/windows8-1.aspx).

Although they have a Windows license, thin clients are categorized in this context, as Windows Embedded is not eligible for VDA in an SA.

VDI licensing, RDS, and virtualization host licensing

Another important aspect of the VDI licensing is that it is not sure which Hypervisor you will decide to use on the virtualization host and which component you will use to provide access to the Windows Client VMs.

From the Hypervisor perspective, you can use either Hyper-V Server, Windows Server with Hyper-V on the Microsoft stack, or you can choose to use another VDI solution, such as VMware Horizon or Citrix XenDesktop.

In the Microsoft stack, the recommendation is the same as the Windows Server virtualization. The first option should be to use the Hyper-V Server as it does not need any additional license and provides all Hyper-V capabilities and features. However, on most of the VDI scenarios, there are other necessary software, like GPU drivers, that are not available for the Hyper-V Server. In these cases, you can use the Windows Server with Hyper-V, but an additional Windows Server license will be necessary for the host OSE.
For other VDI products from other vendors, there are additional licenses which will not be covered here.

In addition to the Microsoft virtualization, RDS is also used on the VDI stack to provide access to the Windows Client VMs. RDS have a totally different approach for licensing in Session Host environments. Session Host environments consist of delivering applications to users through RDS. An RDS Session Host has the option not to expose the underlying OS of the application to the user. It is different from VDI as it is less flexible in exposing the entire OS. VDI, on the other hand, exposes the OS to the user so that the user can have a better experience, but it requires more administrative overhead.

The RDS Session Host must be licensed through RDS CAL. This license is not necessary for VDI and will not be covered here.

As the VDI licensing is more complex than the regular Hyper-V Licensing, it is possible that right now you have more questions than before. To try and answer these questions, let's take a look at a few scenarios and how to license it.

**VDI scenarios and licensing options**

The following are the most frequently asked questions, from customers implementing a VDI environment. It will help you better understand the options for licensing a VDI environment. Remember, all the following scenarios apply to other VDI software using the Windows Client VMs:

- The company has a hundred devices accessing the VDI environment and 150 users. How many VDA licenses does this company need to acquire?
  
  The VDA license is associated to the device. In this case, the company has the option to enable the SA in the contract. If not, the company will have to acquire 100 VDA licenses.

- The company has the VDI environment already licensed. This company is using RDS to support the VDI environment and is planning to use a Session Host for some applications. Is there any other license to acquire?
  
  Yes. The RDS for the Session Host must be licensed apart from the VDI environment. For a Session Host, an RDS CAL must be acquired.

- The company has 150 users. 100 users are using Windows PC devices. 50 users are using iPad. How many VDA licenses does the company need?
  
  If the company has SA enabled in the contract, the 100 Windows PC devices are covered. In this case, the company has to acquire only 50 VDA licenses. If the SA is not enabled, the company has to acquire 150 VDA licenses.
• The company has retired 50 Windows PC devices and replaced them with Windows RT devices. Which license does the company need?

As the company has retired the Windows PC devices, the only option is to acquire 50 VDA licenses. If the company had only added the new Windows RT devices as a second device, the SA would license the Windows RT devices.

• The company has 50 remote users with their own devices, and 50 users based in the office with their devices as well. How many, and which licenses does the company need?

For the remote users, the company can use the benefit of the Roaming Use Rights in the SA, if it is available in the contract. For the office based users, it will depend on the contract. If the contract allows it, the company can acquire CSL on top of the SA. If SA is not available, in both cases, the company will have to acquire a VDA license for each device.

Summary

Licensing a virtualization environment is relatively simple. In this chapter, you learned that licensing a virtualization environment for Windows Server VM is based on accounting the number of processors and VMs in order to decide between the Standard and the Datacenter Editions. You can choose to use Hyper-V Server as a Hypervisor for the virtual environment, especially for Linux VMs. In addition, you can choose to use another Hypervisor, but the Windows Server VM will remain the same.

For the Windows Client VMs in VDI environments, the licensing is relatively simple. Unlike the Windows Server, you have to associate a VDA license for each device accessing the VDI environment. If the company has an SA, there will be benefits for licensing both the Windows Server VMs and the VDI environment.

For the VDI environment, there are some caveats for user-owned devices, and for users from inside and outside the company network.

In the next chapter, we will come back to the technical matter focusing on networking for the host and the VM.
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