



SQL Server 2016

Virtualization Licensing Guide



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Introduction

Virtualization is being employed in a wide range of computing scenarios today, from software development and testing, to disaster recovery and load balancing. To date, one of the major drivers of virtualization has been server consolidation. With the increase in server core density, a typical workload may use just a small fraction of the available computing capacity, and virtualization offers a simple way to carve out and use only the required processing power from server hardware. A key trend today is database virtualization, which allows the database to run in a virtual environment, enabling benefits like more efficient hardware utilization, easier management, and higher availability.

To gain the benefits of database virtualization, Microsoft customers are virtualizing their SQL Server workloads and will increasingly do so. With SQL Server 2016, Microsoft provides licensing options to help customers take advantage of virtualization, and to pay in a more granular and fair way than the industry has typically seen.

In this paper, we will cover the virtualization licensing options available with SQL Server 2016 and take a close look at the key principles involved. Along the way, we will also examine a few real-world scenarios to help illustrate how these principles are put into practice.

Quick overview

Licensing SQL Server 2016 for virtualization

SQL Server 2016 offers customers a unique level of flexibility when licensing in virtual environments – with options to license for maximum/unlimited virtualization or to carve out just the computing power needed by licensing individual virtual machines (VMs). In this document, we will cover each of these options and the related licensing rules in detail. First, let's start with a brief overview of these two paths.

Licensing individual virtual machines

Microsoft offers the unique option to license VMs individually. This is in contrast to other database vendors in the industry that usually require customers to license the entire server, even when the workload utilizes only a fraction of the available computing power. The option to license individual VMs is designed to help organizations use hardware resources more cost-effectively by carving out and paying for just the computing power that is needed. SQL Server can be licensed in individual VMs using the "Per Core" or the "Server+CAL" licensing model.

Per Core licensing model: Purchase a core license for each virtual core (or virtual processor/virtual CPU/virtual thread) allocated to the VM, subject to a four core license minimum per VM.

Server+CAL licensing model: SQL Server 2016 Standard Edition customers purchase one server license for each VM running SQL Server software. In this model, each user or device accessing SQL Server 2016 must also be licensed with a SQL Server 2016 Client Access License (CAL).

Note that individual VMs may also be licensed for SQL Server 2016 Enterprise Edition through the Server+CAL model. See page 7 for more details.

Licensing for maximum virtualization

As virtualized environments grow and become more dynamic, customers have the option to license for maximum virtualization, which can dramatically simplify software licensing management.

- SQL Server 2016 Enterprise Edition customers who have licensed all of the physical cores on the server, and have Software Assurance (SA) coverage for those licenses, may deploy any number of VMs on that server.
- SQL Server 2016 Enterprise Edition customers who have licensed all the physical cores on the server, but who do not have SA coverage, can only deploy a number of VMs equal to the number of core licenses assigned to the server.

SQL Server 2016 Editions				
Licensing option	Enterprise (Per Core)	Enterprise (Server + CAL) *	Standard (Per Core)	Standard (Server+CAL)
Individual virtual machines	•	•	•	•
Maximum virtualization	•			

This table summarizes the virtualization licensing options available for each SQL Server 2016 edition.

*For additional information on licensing the SQL Server 2016 Enterprise Edition in the Server+CAL licensing model, see page 8. For more information on these licensing options, refer to the "SQL Server 2016 Licensing Guide", which can be found here: <http://go.microsoft.com/fwlink/?LinkId=230678>

Next, we will discuss these licensing rules in more detail and walk through a few use cases to help illustrate how these can be applied in real-world scenarios.

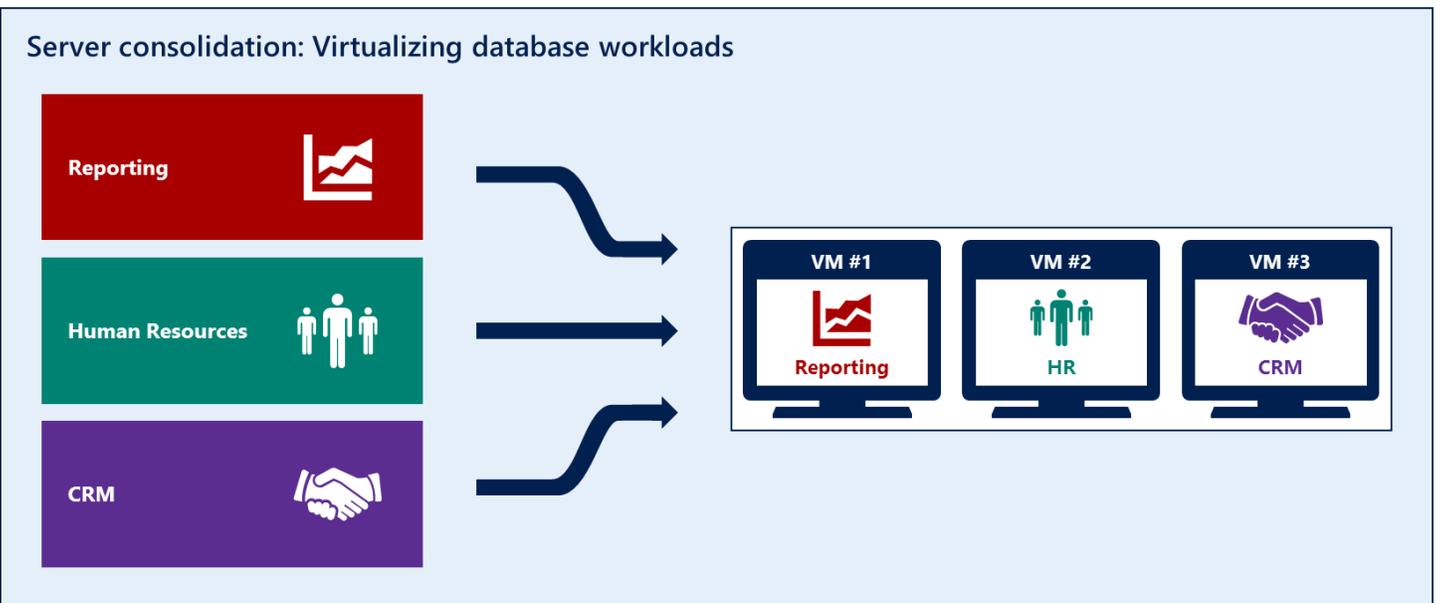
Scenario 1

Server consolidation

Licensing individual VMs

Server consolidation has been a major driver of virtualization in today's IT environments. Virtualizing workloads and consolidating them onto fewer physical servers can improve hardware utilization and reduce server hosting and administration costs.

As an example, consider a manufacturing company that has a reporting workload running on a SQL Server 2016 database, hosted on a dedicated server. Similarly, the company has CRM and HR applications built on SQL Server databases, and each running on their own dedicated server. After purchasing new high capacity hardware, the company decides to virtualize these three workloads and move them to a single server.



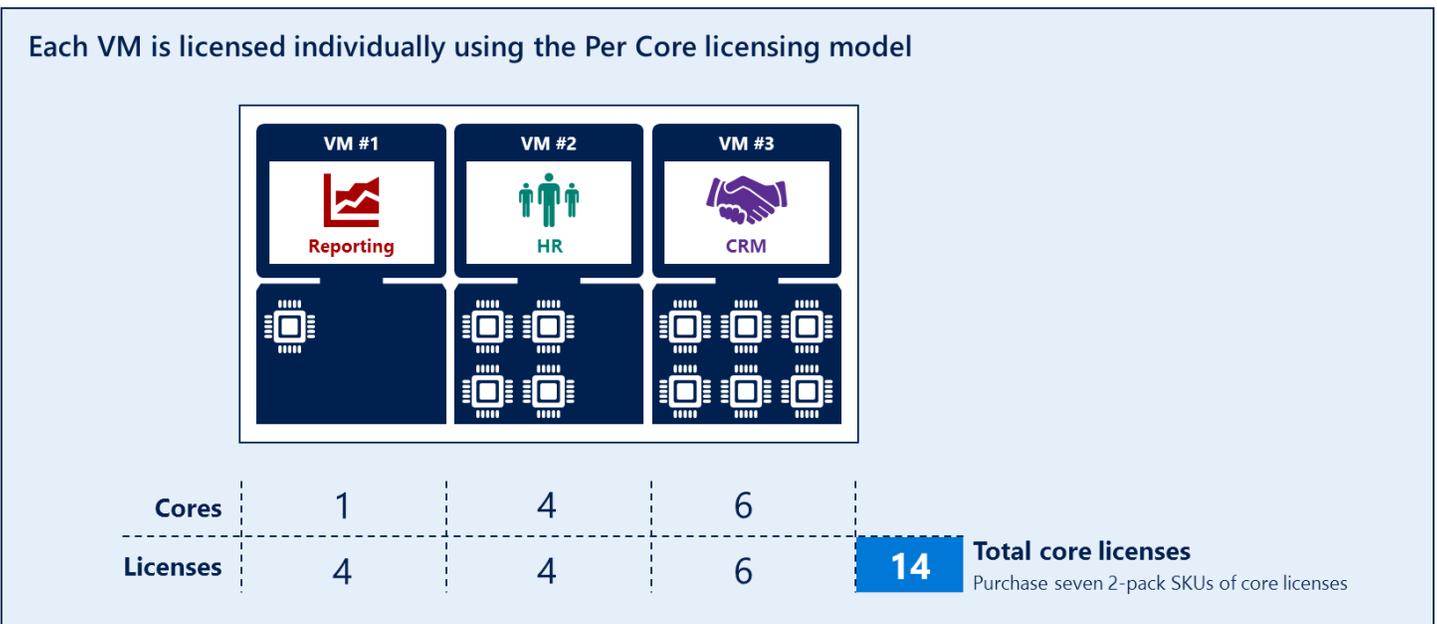
A manufacturing company virtualizes its reporting, HR, and CRM systems and consolidates them onto a single high capacity server.

In this scenario, the company chooses to license each VM individually. This provides the flexibility to license only the computing power required by each SQL Server workload. Let's look in depth at how to license individual VMs in this example using each of the available licensing models.

Licensing individual VMs in the Per Core model

To license each of these VMs in the Per Core licensing model, this customer must purchase a core license for each virtual core allocated to the VM. Consistent with Per Core licensing in the physical environment, there is a four core minimum license requirement for each VM. (Note that for licensing purposes, a virtual core is equivalent to a virtual thread and may also be referred to as a virtual processor or virtual CPU.)

To illustrate this, we'll continue with our manufacturing company example in which three workloads have been virtualized and consolidated on a single server. In this example, these workloads are static and will remain on the server.



The company needs to determine its virtual licensing requirements based on the number of virtual cores in each VM. As you can see in the graphic above:

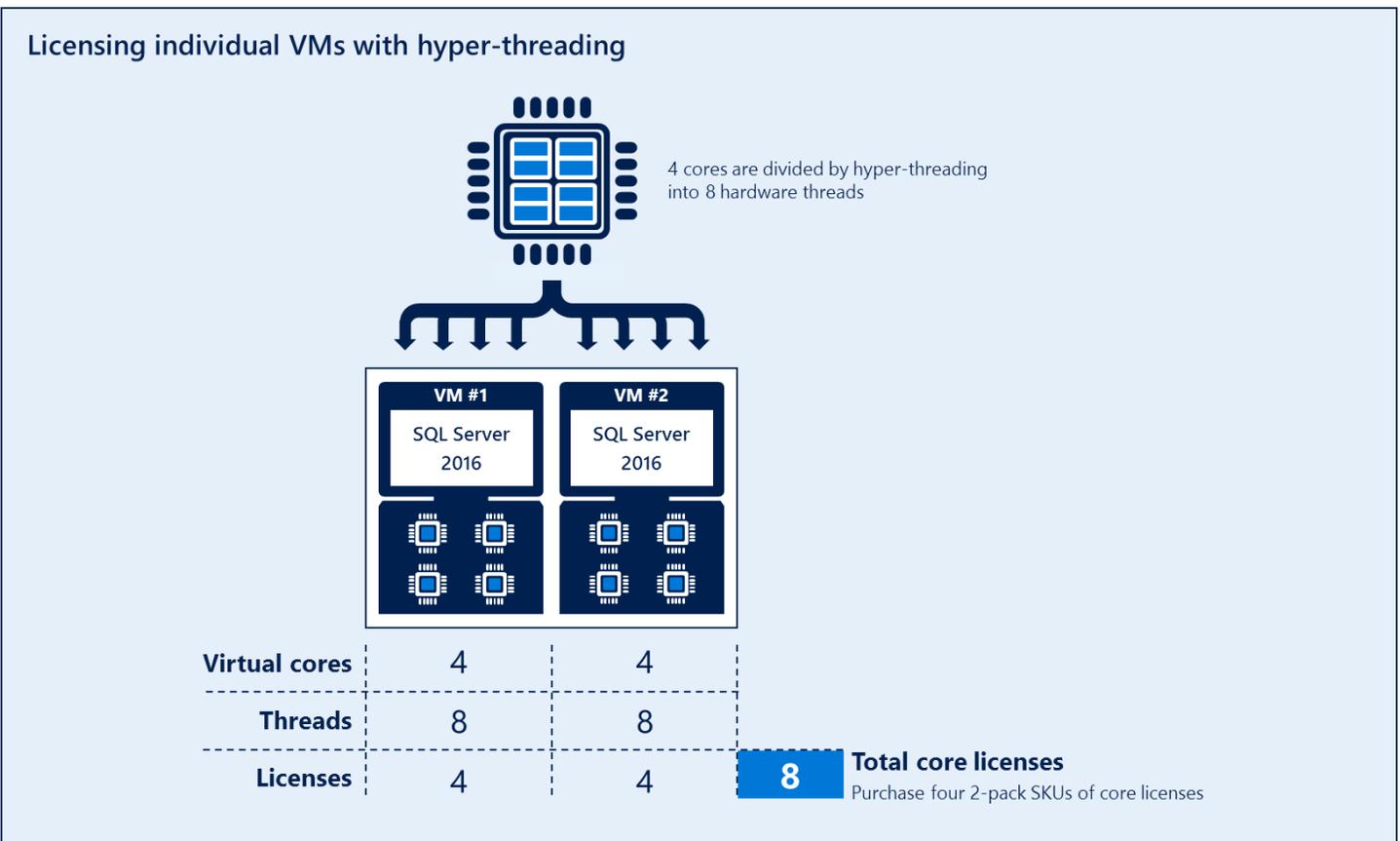
- The first VM with one virtual core requires four core licenses to meet the four core minimum requirement.
- The second VM requires four core licenses, one for each virtual core.
- The third VM requires six core licenses.

As a result, the company purchases a total of 14 core licenses, which are sold in packs of 2-core licenses.

Hyper-threading

For customers using Intel's hyper-threading technology to split a single, physical core into two separate threads of power, there are some additional factors that should be kept in mind when licensing individual VMs using the Per Core Model.

1. When hyper-threading is turned on, a core license is required for each thread supporting a virtual core. In the example below, hyper-threading is enabled for the physical processor supporting a VM. Since hyper-threading creates two hardware threads for each physical core, a total of 8 core licenses would be required in this scenario. A core license allows a single virtual core to be supported by a single hardware thread.
2. Conversely, if a single hardware thread is supporting multiple virtual cores, a core license is still required for each virtual core.



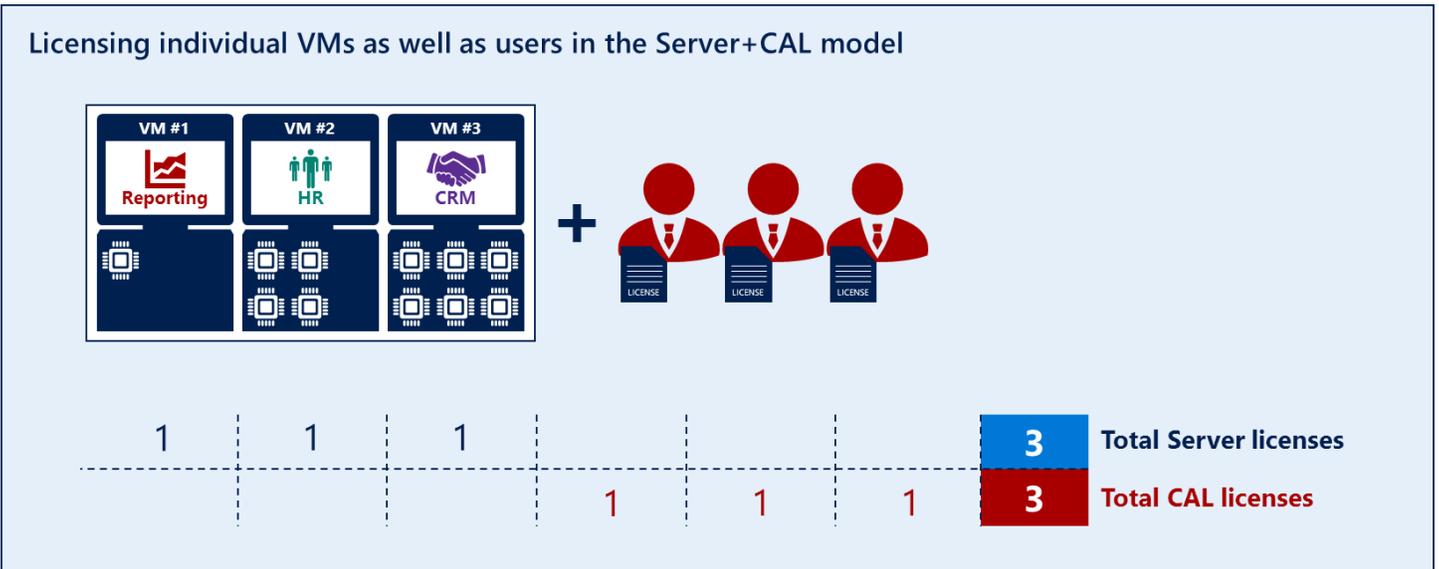
A four core processor with hyper-threading supports two VMs with four virtual cores each.

It should be noted that a customer could license all the physical cores in the server with Enterprise Edition and Software Assurance to gain use rights for unlimited virtualization. This option may be more cost effective and provide greater deployment flexibility. (We will cover this topic in more detail later in the document.)

- For customers with versions prior to SQL Server 2016, please refer to the appendix of this document for information on licensing options and rules.

Licensing individual VMs in the Server+CAL model

Many customers license SQL Server using the Server plus Client Access License (Server+CAL) licensing model, which is based on the users or devices accessing the software. As introduced earlier, these customers can license for virtualization by purchasing one server license for each VM that is running SQL Server software. When licensing VMs, customers can assign multiple server licenses to a single physical server (one for each VM running on that server).



VMs are licensed individually using the Server+CAL licensing model.

Continuing with our manufacturing company example, let's assume that in this case the instances of SQL Server in the physical environment had been licensed under the Server+CAL licensing model. Now, three server licenses will be required for the virtual environment – one for each virtual machine (three Standard Edition server licenses). This is true regardless of the number of virtual processors allocated to the VM. In addition, each user or device accessing SQL Server 2016 software requires a SQL Server 2016 CAL. Note: SQL Server CALs allow access to multiple VMs.

SQL Server 2016 Enterprise Edition Server+CAL customers

Even though the Server+CAL licensing model is no longer available for Enterprise Edition (effective with the release of SQL Server 2012), many customers are able to upgrade their existing software to SQL Server 2016 through Software Assurance. Customers who have deployed SQL Server 2016 Enterprise Edition software in the Server+CAL model are eligible to license up to four VMs for each Enterprise Edition server license. These customers can assign multiple Enterprise Edition server licenses to a single server to deploy additional VMs.

It's important to note that each Enterprise Edition server license is limited to a total of 20 hardware threads of power across the (four or fewer) VMs for which it is licensed. Multiple licenses can be used to add more VMs, but not to increase the amount of compute power used by a single operating system environment (OSE).

See the table below for the number of VMs allowed per server license for each SQL Server 2016 edition.

SQL Server 2016 Edition	VMs per server license
Standard Edition	1
Enterprise Edition	4*

This table shows the number of VMs allowed per server license for each SQL Server 2016 edition.

**Each VM licensed with a single Enterprise Edition server license must be assigned to the same physical server.*

Licensing individual VMs is a great option for organizations that want the flexibility to carve out and license the needed computing power from their hardware. However, as virtual environments become more dynamic and utilize more servers, this may also create a complex set of licensing requirements that must be monitored to ensure compliancy. Next we will discuss how to license SQL Server in more dynamic virtual environments where licensing requirements change frequently to meet shifting business needs.

Scenario 2

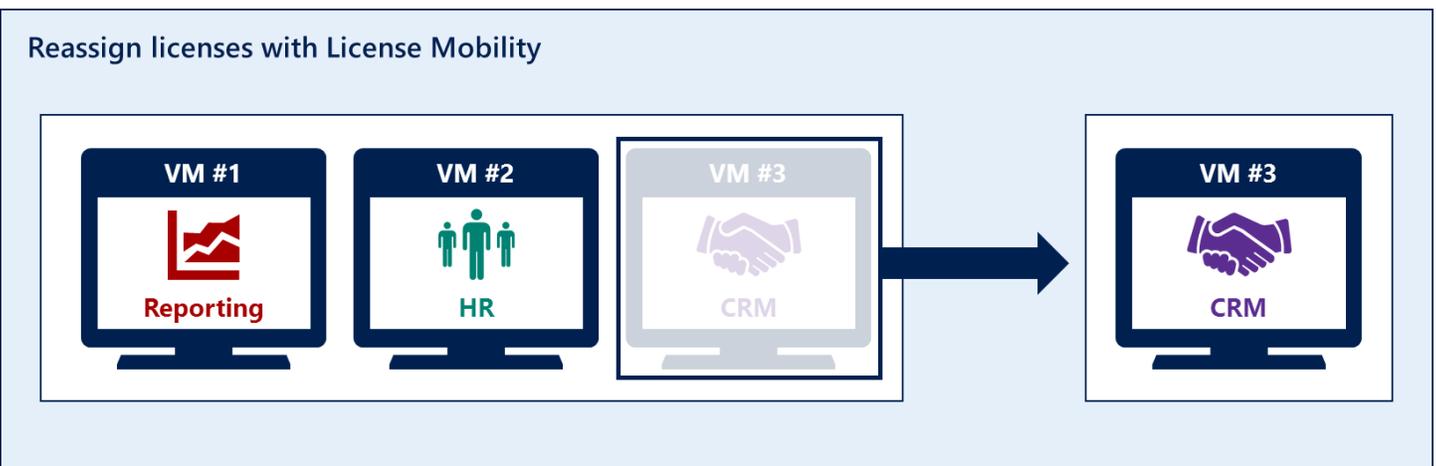
Dynamic virtual environments

Many organizations have virtual computing environments that are dynamic – meaning that the virtual environments are spread across multiple virtual servers, and VMs are moved across these servers occasionally to reallocate resources. In some cases, VMs are moved dynamically by the hypervisor. These dynamic scenarios can make software licensing more complicated, depending on how customers choose to license their virtual workloads. To help simplify licensing for these scenarios and to provide greater flexibility, Microsoft offers License Mobility within server farms, which allows licenses to move between servers along with the VMs.

License Mobility

License Mobility is a benefit available for any edition of SQL Server 2016 software licensed with Software Assurance coverage. License Mobility offers a great advantage to customers who license individual VMs and then need to reassign those licenses to different servers to accommodate moving workloads.

To help understand how License Mobility can be put into practice, consider our manufacturing company example. As the company grows, it adds more physical servers and begins to multiply its workloads across additional VMs. To maximize server utilization, the company periodically “moves” its VMs to different physical servers in its datacenter.



In this graphic, VM #3 is “moved” from one server to another within the server farm.

With License Mobility, this company is able to reassign licenses to different servers within the server farm as often as is needed. So any time one of these VMs moves to a different server, the license moves with it. This can provide significant cost savings as well as simplicity in licensing. Without License Mobility, the company could only move licenses to a different server once every 90 days, which for this example means the company would need to maintain enough licenses on each server to cover the peak number of VMs that could be moved to the server at any time.

Another scenario in which License Mobility can help save costs is when organizations host virtualized workloads both in their datacenters and in the public cloud. As these “hybrid” IT infrastructures grow and become more dynamic, customers can move a workload to a VM role in the cloud and seamlessly move the license with it. License Mobility provides the flexibility to help address this need.

There are a few additional considerations to be aware of with License Mobility:

1. As mentioned earlier, customers with SQL Server Enterprise Edition Server+CAL licenses can license up to four VMs per server. If customers intend to use this licensing model in a dynamic environment, it’s important to note that to gain the benefits of License Mobility, the VMs licensed with a single Enterprise Edition server license must move together to the same server at the same time. This may not always be possible, in which case customers must assign one Enterprise Edition server license to each VM being deployed.
 2. A server farm may consist of up to two data centers located in time zones that are within four hours of one another and/or with the European Union (EU) and/or European Free Trade Association (EFTA).
 3. While License Mobility allows dynamic movement of VMs within a server farm at any time, SQL Server licenses can only move to VMs hosted by third party providers once every 90 days.
- For more detailed information on License Mobility, refer to the “SQL Server 2016 Licensing Guide”, which can be found here: <http://go.microsoft.com/fwlink/?LinkId=230678>

Today, many virtual environments are becoming even more dynamic, especially in scenarios where software is used to automatically and dynamically allocate resources to different VMs “on the fly”. In the next section, we will discuss licensing SQL Server in these scenarios and look at ways to further simplify licensing management.

Scenario 3

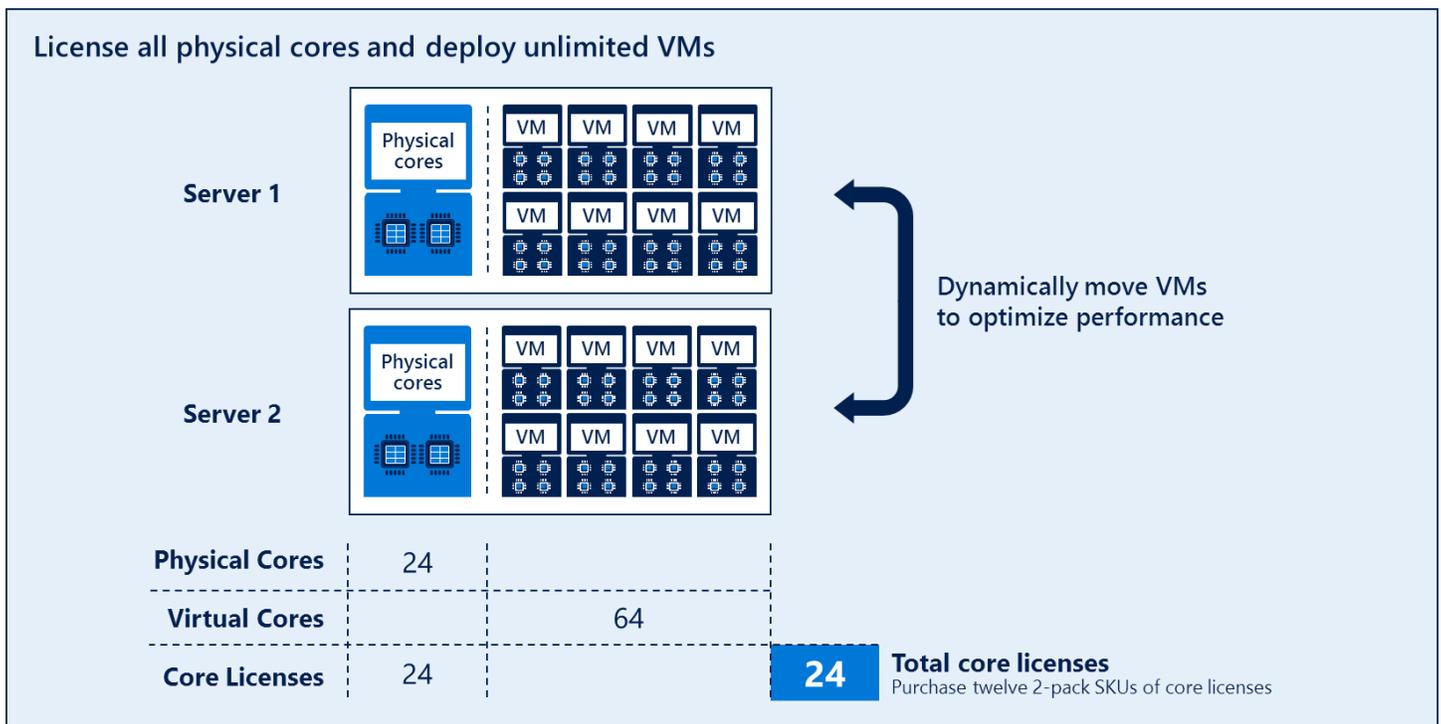
High volume dynamic virtual environments

Licensing for maximum virtualization

For organizations with a large number of VMs and complex, highly dynamic virtual environments, Microsoft offers the option to license for maximum virtualization. This means that when all of the cores on a server are licensed with SQL Server Enterprise core licenses and covered with Software Assurance, a customer can deploy any number of VMs on the server.

The key benefits of licensing for maximum virtualization are simplicity and potential cost savings. Maximum virtualization ensures that customers are covered, without needing to be concerned with tracking individual VMs or the amount of power assigned to each VM. This is especially relevant for private cloud scenarios with a large number of VMs being moved dynamically between different physical servers, when self-provisioning is enabled, or when hyper-threading is turned on.

As an example of how maximum virtualization can be employed, let's look at the creation of a private cloud infrastructure, where hundreds of databases are consolidated into a single virtual environment.



A high volume of VMs are dynamically "moved" across servers.

In this scenario, an organization has deployed high performance hardware, where the physical servers are combined as a pooled virtual resource that supports a large number of VMs. Further complicating this scenario for licensing purposes is that the VMs are being moved dynamically between the server blades in the appliance to maintain peak performance.

By licensing all of the physical cores in the appliance with SQL Server Enterprise core licenses, and covering those licenses with Software Assurance, the organization can deploy an unlimited number of VMs. This can dramatically simplify licensing, as the organization can be assured that all VMs are correctly licensed, even when they are dynamically moved across the different servers in the appliance. The customer can also spin up as many new VMs as they need without ever needing to buy additional licenses.

One important factor when licensing for maximum virtualization is to determine which use rights apply. When deploying VMs on a server, the use rights of the most recent licensed version apply to every VM on the server. For instance, if a customer is using SQL Server 2008 R2 processor licenses (with Software Assurance), to license for maximum virtualization and upgrades any of the VMs to SQL Server 2016, SQL Server 2016 use rights would now apply for every VM running on that server.

In scenarios like this one, it may still be possible to license VMs individually but it is likely to be difficult to manage. There are a few caveats to consider when licensing individual VMs in highly dynamic environments.

- **SQL Server 2016 Enterprise Edition Server+CAL customers**

As mentioned earlier, in dynamic environments like this, customers would need to assign an Enterprise Edition server license to each VM to ensure that they are properly licensed at all times. While customers can license up to four VMs with a single Enterprise Edition server license, as VMs are moved dynamically in this scenario, it would be impossible to ensure that all four VMs move together across the servers. In this case, License Mobility will not work and it is strongly recommended that one Enterprise Edition server license is assigned to a single VM.

- **Dynamically changing power usage in VMs**

In some scenarios, the power allocated to each VM is scaled up and down dynamically to meet the changing needs of the workload and to maximize server utilization. In this case, it may be impossible to track virtual core-based usage if customers license individual VMs with core licenses.

Summary

Microsoft offers a wide range of licensing options to help customers deploy SQL Server in virtual environments. With the unique ability to license VMs individually, customers can start small and scale their virtual deployments as needed, carving out just the computing power required from server hardware. With License Mobility, customers have the flexibility to move licenses with their virtual workloads to support the requirements of dynamic environments. By licensing for maximum virtualization, customers can dramatically improve licensing simplicity as they scale their virtual environments. This option offers the customers confidence that they are covered in scenarios that require a large number of VMs and highly dynamic environments.

For more information:

- Download the “Licensing Microsoft Server Products in Virtual Environments” Volume Licensing Brief, which can be found here: <http://www.microsoft.com/licensing/about-licensing/briefs/virtual-licensing.aspx>
- Download the “SQL Server 2016 Licensing Guide” and other SQL Server licensing resources here: <http://www.microsoft.com/en-us/cloud-platform/sql-server-2016-pricing>
- Visit the “License Mobility Through Software Assurance” website found here: <http://www.microsoft.com/licensing/software-assurance/license-mobility.aspx>

Appendix

SQL Server virtualization rights for prior software releases

The following overview summarizes the software virtualization rights for current and prior versions, editions and licensing models of SQL Server software. This summary should not be a substitute for careful review and understanding of your rights and obligations as described in your Microsoft Volume Licensing agreement and the Product Terms. When reviewing virtualization rights for prior versions, it's important to keep these things in mind:

1. Product use rights for the originally licensed version and edition apply even if using downgrade or cross-edition deployment rights. For example, if a customer purchases a SQL Server 2016 license, SQL Server 2016 use rights apply even if the customer deploys SQL Server 2012 (or an earlier version).
2. If customers (who are eligible through SA) have upgraded from a previous version, the product use rights for the running software version apply. For example, if a customer upgrades from SQL Server 2008 to SQL Server 2016, SQL Server 2016 use rights apply.
3. License Mobility moved to an SA benefit with the release of SQL Server 2012. So any license covered with SA, regardless of which version or edition of the software is deployed, will have License Mobility rights.

SQL Server 2005	Licensing individual VMs	Licensing for maximum virtualization	License mobility allowed
Standard Edition Server+CAL	1 server license per VM.	N/A – Additional VMs must be licensed individually.	No
Enterprise Edition Server+CAL	4 VMs per server license.	Each server license allows running in an unlimited number of VMs on server.	No
Standard Edition Per Processor	See processor license requirements for individual VMs below.	N/A – Additional VMs must be licensed individually.	No
Enterprise Edition Per Processor	See processor license requirements for individual VMs below.	When all physical processors are licensed, allows running in an unlimited number of VMs on the server.	No

Note: SQL Server 2005 or earlier software can be deployed under these use terms

SQL Server 2008	Licensing individual VMs	Licensing for maximum virtualization	License mobility allowed
Standard Edition Server+CAL	1 server license per VM.	N/A – Additional VMs must be licensed individually.	No
Enterprise Edition Server+CAL	4 VMs per server license.	Each server license allows running in an unlimited number of VMs on server.	Yes
Standard Edition Per Processor	See processor license requirements for individual VMs below.	N/A – Additional VMs must be licensed individually.	No
Enterprise Edition Per Processor	See processor license requirements for individual VMs below.	When all physical processors are licensed, allows running in an unlimited number of VMs on the server.	Yes

Note: SQL Server 2008 or earlier software can be deployed under these use terms.

SQL Server 2008 R2	Licensing individual VMs	Licensing for maximum virtualization	License mobility allowed
Standard Edition Server+CAL	1 server license per VM.	N/A – Additional server license required for each VM.	No
Enterprise Edition Server+CAL	4 VMs per server license.	N/A – Additional server licenses add 4 VMs per license. <i>(Note: the previous availability of a temporary use right allowing unlimited VMs for SA customers expired 4/1/2012.)</i>	Yes
Standard Edition Per Processor	See processor license requirements for individual VMs below.	N/A – Additional VMs must be licensed individually.	No
Enterprise Edition Per Processor	See processor license requirements for individual VMs below.	N/A – When all physical processors are licensed, allows running in up to 4 VMs only. <i>(Note: the previous availability of a temporary use right allowing unlimited VMs for SA customers expired 4/1/2012.)</i>	Yes
Datacenter Edition Per Processor	See processor license requirements for individual VMs below.	When all physical processors are licensed, allows running in an unlimited number of VMs on the server. Requires a minimum of 2 processor licenses.	Yes

Note: SQL Server 2008 R2 or earlier software can be deployed under these use terms.

SQL Server 2012/2014	Licensing individual VMs	Licensing for maximum virtualization	License mobility allowed
Standard Edition Server+CAL	1 server license per VM.	N/A – Additional VMs must be licensed individually.	Only with SA
Business Intelligence Server+CAL	1 server license per VM.	N/A – Additional VMs must be licensed individually.	Only with SA

SQL Server 2012/2014	Licensing individual VMs	Licensing for maximum virtualization	License mobility allowed
Enterprise Edition Server+CAL	4 VMs per server license.	N/A – Additional server licenses add 4 VMs per license.	Only with SA
Standard Edition Per Core	1 core license for each virtual core supporting the VM. Requires a minimum of 4 core licenses.	N/A – Additional VMs must be licensed individually.	Only with SA
Enterprise Edition Per Core	1 core license for each virtual core supporting the VM. Requires a minimum of 4 core licenses.	When all physical cores are licensed with SA , allows running in an unlimited number of VMs on the server. Requires a minimum of 4 core licenses. When all physical cores are licensed without SA, allows running in 1 VM per core license. Requires a minimum of 4 core licenses. Additional core licenses add 1 VM each.	Only with SA

Note: SQL Server 2014 or earlier software can be deployed under these use terms.

SQL Server 2016	Licensing individual VMs	Licensing for maximum virtualization	License mobility allowed
Standard Edition Server+CAL	1 server license per VM.	N/A – Additional VMs must be licensed individually.	Only with SA
Enterprise Edition Server+CAL	4 VMs per server license.	N/A – Additional server licenses add 4 VMs per license.	Only with SA
Standard Edition Per Core	1 core license for each virtual core supporting the VM. Requires a minimum of 4 core licenses.	N/A – Additional VMs must be licensed individually.	Only with SA
Enterprise Edition Per Core	1 core license for each virtual core supporting the VM. Requires a minimum of 4 core licenses.	When all physical cores are licensed with SA , allows running in an unlimited number of VMs on the server. Requires a minimum of 4 core licenses. When all physical cores are licensed without SA, allows running in 1 VM per core license. Requires a minimum of 4 core licenses. Additional core licenses add 1 VM each.	Only with SA

Note: SQL Server 2016 or earlier software can be deployed under these use terms.

Additional notes when licensing individual VMs:

Under the **Server+CAL** licensing model, SQL Server CALs are required for any user or device accessing SQL Server functionality or data, regardless of whether SQL Server or any of its components are running a physical or virtual OSE.

When licensing individual VMs under the **Per Core** licensing model, all virtual cores supporting the VM must be licensed, with a minimum of four core licenses required. No additional CALs are required. For licensing purposes, a virtual core maps to a core (when hyper-threading is turned off) or a hardware thread (when hyper-threading is on).

When licensing individual VMs under the legacy **Per Processor** licensing model, all virtual processors (v-cores) supporting the VM must be licensed. No additional CALs are required. For licensing purposes, a virtual processor maps to a core (when hyper-threading is turned off) or hardware thread (when hyper-threading is on). To calculate the number of processor licenses required for each VM, divide the number of virtual processors in the VM by the number of physical cores (or threads) per physical processor. If this results in a fraction, round up to the next whole number.