Microsoft

Hyper-V is the best virtualization solution for SQL Server

SQL Server White Paper

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Applies to: SQL Server 2008, SQL Server 2008 R2

Summary:

Many customers are looking to consolidate their SQL Server databases in order to optimize hardware usage and licensing. Both Microsoft Hyper-V and VMware vSphere provide hardware virtualization support for SQL Server in production environment.

However, customers enjoy many Hyper-V advantages over VMware for SQL Server workloads:

- Similar performance: Hyper-V provides near native performance characteristics for SQL Server virtualization and is comparable with VMware.
- More extensive high availability (HA): For SQL Server Failover Clustering scenario, customers retain full Hyper-V functionalities whereas VMware recommends turning off key features such as vMotion for VM mobility, DRS for dynamic resource allocation, and memory overcommit.
- Superior management: Hyper-V combined with System Center provides both physical and virtualized management as well as support for Hyper-V and VMware virtual machines management. VMware only supports virtualized management for VMware virtual machines.
- More extensive monitoring: Hyper-V combined with System Center provides complete in-guest monitoring (hardware, hypervisor, operating system, and application). VMware does not support application monitoring.
- Lower costs: Finally, Hyper-V provides a lower total cost of ownership (TCO) than VMware vSphere for initial licensing and ongoing operations.

In summary, Hyper-V proves to be a cost-effective solution that meets customers' need to virtualize SQL Server databases with equal performance but substantial saving on the TCO and better functionalities in Failover Clustering scenario compared with VMware.

Hyper-V is the best virtualization solution for SQL Server

The following table shows the comparison from Hyper-V and VMware; these are covered in more detail in this paper.

Features	*Microsoft Hyper-V*	*VMware*
Near Native Performance	✓	✓
Full support for SQL Server Failover Clustering	✓	
Physical and Virtual Management for Hyper-V and VMware virtual machines	✓[1]	
In-guest Monitoring	✓[1]	
Lower Total Cost of Ownership (TCO)	✓	

[1]Microsoft Hyper-V and System Center

Many customers understand the benefits outlined in the summary and table above. To realize those benefits, they have chosen to run their SQL Server using Hyper-V or have switched their existing SQL Server to Hyper-V from VMware. More details on their benefits can be obtained through these case studies.

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Introduction and Overview

Customers continuously find a new way to optimize their datacenter usage through consolidation. Over the last several years, virtualization is becoming one of the most popular ways to get more out of the hardware resources. Virtualization also provides additional benefits such as the ability to reduce power consumption, gain operational agility, and increase application availability. Microsoft Hyper-V and VMware provide hypervisors to do hardware virtualization. Hyper-V is an optimal virtualization platform to use for deploying demanding and mission critical production applications including Microsoft SQL Server database workloads.

SQL Server is a complete set of enterprise-ready technologies and tools that help customers derive the most value from information at the lowest total-cost-of-ownership. In fact, according to IDC, SQL Server is the fastest growing database and business intelligence vendor and ships more units than its competitors Oracle and IBM DB2. Microsoft supports SQL Server running in virtualized environment for Hyper-V and non-Microsoft hypervisors. This paper shows the benefits of SQL Server on Hyper-V over VMware hypervisor.

Performance

With Hyper-V, multiple virtual instances running SQL Server OLTP and OLAP workloads can achieve essentially the same throughput and performance as running in physical environment.

Hyper-V features are able to take full advantage of advanced virtualization technologies on the latest server processors such as hardware second level address translation (SLAT). AMD describes its SLAT technology as AMD Virtualization™ (AMD-V™) Rapid Virtualization Indexing (RVI) or nested paging tables (NPT). Intel describes their SLAT technology as Intel Virtualization - Extended Page Tables (VT-EPT). Current servers equipped with the latest processors from Intel or AMD not only provide hardware assisted virtualization; they also perform virtual memory management and other functions that were traditionally fulfilled by the hypervisor. This capability substantially benefits the workload because it improves overall system performance. Hyper-V

takes full advantage of these hardware features to produce close to native performance of virtual SQL Server instances.

More details on SQL Server performance on Hyper-V can be obtained through these white papers: High Performance SQL Server Workloads on Hyper-V and Running SQL Server 2008 in Hyper-V environment Best Practice and Performance.

High Availability Scenario

To support "24x7" availability of their mission critical applications, many companies require their SQL Server database to be available virtually all of the time, with system downtime kept to an absolute minimum.

Failover clustering is the only approach that enables an entire SQL Server instance to be made highly available – either at the local data center or possibly at a remote site or data center. A SQL Server failover cluster relies on the broadly adopted Windows Server Cluster technology. SQL Server customers prefer failover clustering to make sure database instances are highly available especially for mission critical applications. More SQL Server customers implemented failover clustering over other high availability technologies such as database mirroring. Because of its popularity and high preference, the next version of SQL Server codename "Denali" will make use of Windows Clustering as the base technology for AlwaysOn, its new high availability solution that is flexible, interoperable, and efficient.

VMware placed many restrictions on its features for SQL Server failover clustering. The details of these restrictions are outlined in page 11 and 34 of VMware white paper Setup for Failover Clustering and Microsoft Cluster Service for the latest versions of VMware ESX 4.1, ESXi 4.1, and vCenter Server 4.1.

Page 11 of VMware paper mentions a list of functions that are not supported for Microsoft Cluster Services (MSCS).

- *Clustering on iSCSI, FCoE, and NFS disks.*
- *Mixed environments, such as configurations where one cluster node is running a different version of ESX/ESXi than another cluster node.*
- *Use of MSCS in conjunction with VMware Fault Tolerance.*
- *Migration with vMotion of clustered virtual machines.*
- *N-Port ID Virtualization (NPIV)*
- *With native multipathing (NMP), clustering is not supported when the path policy is set to round robin.*
- *You must use hardware version 7 with ESX/ESXi 4.1.*

Page 34 of VMware paper recommends not to use memory overcommit.

In summary, customers who are using failover clustering on VMware will lose the following:

- No VM mobility because vMotion is not supported. vMotion is a VMware technology that enables virtual machines to be migrated live from server to server. This is a substantial restriction as it is one of the key reasons and benefits of hardware virtualization.
- No dynamic resource allocation because Dynamic Resource Scheduler (DRS) is not supported. DRS is a VMware technology that monitor resource pool utilization and intelligently load balance virtual machines to obtain optimum resource pool usage.
- No virtual SAN because N-Port ID Virtualization (NPIV) is not supported. NPIV allows multiple fiber channels to occupy a single physical port in Storage Area Network (SAN) storage.
- No zero loss protection because VMware Fault Tolerance is not supported.
- Less flexibility and performance because memory overcommit is not recommended. Memory overcommit is a VMware feature that can identify idle memory and dynamically reallocate unused memory from some VMs to others that need more memory.

On the other hand, Hyper-V provides better features compared to VMware for SQL Server running in failover clustering scenario and customers retain all Hyper-V advanced features:

- Live Migration. It is a Hyper-V technology that allows a server administrator to move a running virtual machine or application between different physical machines without disconnecting the client or application.
- Mixed guest/host cluster configuration. It is having both physical and virtual nodes in the same cluster.
- Dynamic memory. It is a Hyper-V technology that allows the memory assigned to guest virtual machines to vary according to demand.
- N-Port ID Virtualization (NPIV) support through System Center Virtual Machine Manager. NPIV allows multiple fiber channels to occupy a single physical port in Storage Area Network (SAN) storage.

Management

Virtual machines are not simply objects to manipulate, but actual computers with real workloads. It is imperative to manage virtual machines the same way as managing physical systems. System Center Management Suite Datacenter (SMSD) provides a comprehensive set of integrated management tools for physical and virtual machines. Customers can keep complexity at a minimum and streamline operations with a common management environment that reduces training, ensures uniform policy application, and simplifies maintenance by utilizing existing software, personnel, and most importantly, existing IT management process.

More details on System Center management can be obtained through this site.

On the other hand, VMware does not provide physical system management as it only focuses on virtualization management on virtual machines and hypervisor host.

Monitoring

As organizations incorporate virtualization into their IT services infrastructure, they have access to new capabilities that can increase efficiency, flexibility, and application uptime. IT services infrastructure can be categorized into the following layers: hardware, hypervisor, operating system, and application. The hardware layer includes server, networking, and storage. The hypervisor layer includes events, configuration, and performance data related to hypervisor such as Hyper-V. The operating system layer includes Windows Server and other operating systems. And the application layer includes events, configuration, and performance data related to applications like SQL Server, or line of business (LOB) applications built on SQL Server.

To fully benefit from these new capabilities, customers require monitoring software that fully integrates virtualization capabilities that include in-guest monitoring capabilities. Monitoring software that does not combine information about hardware, hypervisor, operating system, and applications into a single console, or that shows causal relationships between components, will be less effective in helping IT staff both respond to service interruptions quickly and maximize datacenter efficiency. In particular, monitoring and management software that does not have deep visibility into the application layer will be missing vital information that could otherwise help maximize uptime. Monitoring tools that only inspect the operating system and hypervisor layers can miss vital application-layer warnings that can quickly escalate into service outages that effect users.

System Center in-guest monitoring combines visibility into the hardware, hypervisor, operating system, and applications layer with a single console interface that illustrates relationships between layers of the IT infrastructure, along with insight into end-user experiences or system-related transactions, to help IT staff maximize both uptime and datacenter efficiency.

On the other hand, VMware vCenter does not provide deep visibility into the applications running within VMs. VMware's monitoring tool vCenter lacks in-guest monitoring capabilities. Instead, vCenter relies on packet inspection of network data to and from applications running within a VM. In addition, vCenter does not gather information directly from applications. While vCenter does gather information about current application performance, throughput, and latency, vCenter does not have visibility into many in-guest conditions that ultimately lead to an application outage.

System Center fully integrates virtualization monitoring and management into existing monitoring capabilities. With System Center, organizations gain the ability to fully integrate virtualization as a core capability in a dynamic, self-managing IT services infrastructure.

More details on System Center monitoring can be obtained through this white paper: In-Guest Monitoring with System Center.

Total Cost of Ownership

Understanding the costs of licensing and ongoing operational allows customers to make a more informed decision when deciding which hypervisor is best for their organization. There are substantial functionality and price differences between these two solutions. In general, VMware

approaches virtualization as a niche infrastructure addition while Microsoft approaches virtualization as an integrated infrastructure commodity.

While both Microsoft and VMware's pricing structure causes overall solution price to scale with the number of servers used, VMware's pricing structure simply charges more for less overall functionality. By virtualizing with Microsoft solutions, customers save up to one-third the cost of a comparable VMware solution[2]. With the greater functionality of System Center, including the only solution for in-guest management and automated VM optimization using in-guest knowledge, the Microsoft solution provides more value in scenarios from five servers all the way through to large enterprise deployments of 200 servers or more. This makes Microsoft the better value for organizations of any size.

More details on licensing cost comparison between Hyper-V and VMware can be obtained through this white paper: Cutting Costs with Microsoft Virtualization and this site.

While Microsoft provides better value than VMware for initial licensing cost, research also shows that customers running Hyper-V spend 24% less on IT labor, on an ongoing basis, than customers using either VMware ESX or vSphere. More details on ongoing operation cost comparison between Hyper-V and VMware can be obtained through this white paper: Microsoft Hyper-V vs. VMware ESX & vSphere: Operations & Management Cost Analysis.

Customer Case Studies

Microsoft virtualization saves customers significantly more money and enables greater agility than VMware, while providing the key capabilities they need and enabling them to utilize the expertise they already have from using other Microsoft products. Companies with existing VMware who are starting to look for tangible, bottom-line benefits from virtualization put cost at the top of their list. That's why, when organizations want to expand the initial virtualization environments they built using VMware into larger-scale implementations, many of them move to Microsoft.

Following table is a sampling of SQL Server customers that have chosen Microsoft virtualization over VMware.

Customer	*Industry*	*Location*	*In Their Own Words*
University of Waterloo	Education	Canada	"We're now cost-effectively operating within a more virtualized IT environment with Hyper-V – especially when compared to how much we estimate it would have cost to run VMware in the same capacity."
Fpweb.net	SaaS	United States	"With VMware, we would face an up-front licensing cost of $100,800, which would force us to increase our pricing. By comparison, when we licensed Windows Server 2008 Enterprise, Hyper-V was included for free."
Ayala	Professional Services	Philippines	"Even after VMware cut its costs to be more competitive, we were still able to realize a more cost-effective solution with Microsoft by using

			the Windows Server 2008 Datacenter edition."
1800GOTJUNK	Services	Canada	"We've been happy with the overall performance and reliability of Hyper-V and the cost for Hyper-V servers is much less than it is for physical hardware, which helps our bottom line."
Lee Company	Constructions	United States	"By deploying Hyper-V instead of VMware, we saved about $15,000 in licensing fees."
Urban Lending Solutions	Banking	United States	"Sure, it was a lot cheaper to go with Hyper-V. But that was a side benefit; we went with it because it's the better virtualization solution."
La Direction des Domaines de l'Etat	Government	Morocco	"Compared with other virtualization suppliers in Morocco, Microsoft provides us with peace of mind. We can plan for the future and deploy new applications knowing that our systems will expand cost-effectively to meet demand"

Following table is a sampling of SQL Server customers that have switched from VMware to Microsoft virtualization.

Customer	*Industry*	*Location*	*In Their Own Words*
CH2M HILL	Architecture, Engineering	United States	"The company was cutting costs across the board, and we wanted to push forward with virtualizing more servers, especially in our field offices, but we just couldn't do it with VMware."
Union Pacific	Transportation, Logistics	United States	"We would not have been able to proceed as aggressively with virtualizing our Windows production workloads without the move to Hyper-V."
Apps4Rent	SaaS	United States	"With Hyper-V, Apps4Rent has a competitive advantage. Using a Microsoft virtualization solution, we can serve more customers more efficiently and cost effectively than we ever could with VMware"
Avanade	IT Services	United States	"Hyper-V was significantly more cost-effective than those VMware licenses we had used for our test and development environment"
Crutchfield	Retail	United States	"Since deploying Hyper-V, IT has shown a new level of agility and responsiveness. Thanks to our Microsoft virtualization solution, we are meeting the needs of the business while minimizing costs"
University of Miami	Education	United States	"Microsoft virtualization solutions cost us 60 percent less than VMware. They help us save money today while giving us the capabilities needed to operate even more efficiently and cost-effectively as time goes on"
Children's Hospital	Healthcare	United States	"[With System Center and Hyper-V] we can do more with a smaller staff; plus, we've been able to redeploy staff to higher-value projects."
Swedish Red Cross	Non-profit	Sweden	"Saving money was certainly part of the appeal of Windows Server 2008, but we also knew that with a pure Microsoft solution, we could

			manage our entire infrastructure ourselves and get rid of expensive VMware consultants"

More details on the customers' benefits from using Hyper-V over VMware can be obtained through these case studies.

Conclusion

Microsoft fully supports running SQL Server workloads with Hyper-V. Microsoft Hyper-V has many advantages over VMware for SQL Server in the area of performance, full support for Failover Clustering scenario, holistic physical and virtual management, application monitoring, faster to market with appliance, and overall lower TCO for both initial licensing and ongoing maintenance costs.

Hyper-V is a cost-effective solution that meets customers' need to virtualize SQL Server databases with equal performance but substantial saving on the licensing/ongoing maintenance costs and better functionalities in Failover Clustering scenario compared with VMware.

Many customers understand the benefits of running SQL Server with Hyper-V by choosing Hyper-V or migrate from their existing VMware implementation. More details on their benefits can be obtained through these case studies.

For more information:

- http://www.microsoft.com/sqlserver
- http://www.microsoft.com/virtualization
- http://www.microsoft.com/hyper-v

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[2] Based on a server virtualization comparison of Microsoft® System Center Server Management Suite Datacenter with VMware's vSphere Enterprise Plus with VMware vCenter Server. Cost comparisons assumes a five host configuration, 2 processors on each host, 2 years support costs for both products, and no operating system costs included. The Microsoft solution can use either the free Microsoft Hyper-V Server 2008 R2 hypervisor or an existing Windows Server 2008 R2 hypervisor. Based on Microsoft estimated retail prices and published VMware prices as of 08/01/2010 for purchases in the United States. Actual reseller prices may vary.