**ESG Lab
Summary**

Hyper-V R2 SP1 Application Workload Performance

Virtualizing SQL Server, SharePoint, and Exchange with Confidence

This report presents a summary of Microsoft-commissioned testing of the performance and scalability of Hyper-V R2 SP1 server virtualization technology. SharePoint 2010, Microsoft SQL Server 2008 R2, and Exchange 2010 workloads were tested with Microsoft Windows 2008 R2 SP1 to confirm that Hyper-V R2 SP1 can be used to virtualize tier-1 applications to lower total cost of ownership, increase scalability, and maintain performance.
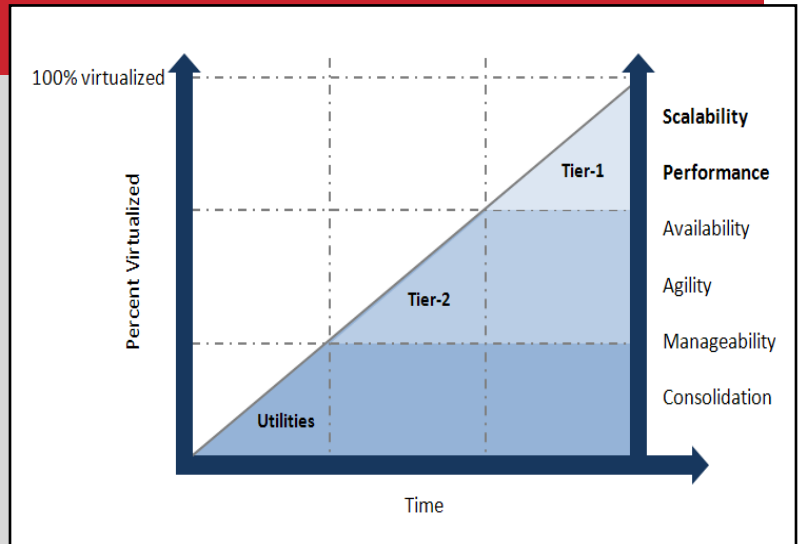
**Learn more at
www.microsoft.com/virtualization**

Hyper-V R2 SP1

Microsoft Hyper-V is a bare metal hypervisor that enables hosting of multiple virtual machines on the same physical server. Hyper-V R2 SP1, first released in September 2009, includes a number of enhancements that improve the performance and scalability of virtualized application workloads:

- **Storage-specific Enhancements** to processor utilization, IO performance, iSCSI connection performance, multi-path performance, fault tolerance, configuration error recovery, and overall storage solution manageability.

- **Dynamic Memory** to allow the virtualization server to pool and dynamically add or remove memory based on virtual machine usage, allowing for higher consolidation ratios.

- **Live Migration and Clustered Shared Volumes** to enhance the serviceability and mobility of virtualized application workloads.

- **Increased Scale-out and Scale-up Workload Support** to improve the resource efficiency and performance of virtualized application workloads compared to previous versions of Microsoft Windows Server.

A growing number of businesses are looking beyond the initial benefits of increased consolidation and manageability that have been achieved with server virtualization. And yet, according to ESG research, 59% of organizations have not yet virtualized tier-1 applications. Performance concerns are among the top reasons cited as preventing companies from using virtualization more pervasively. This report summarizes the results of ESG Lab testing designed to evaluate the performance and scalability of a fully virtualized Hyper-V R2 SP1 infrastructure running Microsoft Exchange, SQL Server, and SharePoint workloads.

Why This Matters

A recent ESG survey indicates that "increased use of server virtualization" is the number one IT priority for the next 12-18 months. Yet despite the desire to increase server virtualization usage, nagging issues and challenges exist: scalability, performance, and availability are key concerns that must be addressed before organizations can move from a strategy of lowering costs via consolidation of IT utility and productivity applications to improving quality of service for tier-1 business-critical applications such as Microsoft SQL Server, SharePoint, and Exchange. Microsoft Server 2008 R2 SP1 increases the performance and scalability of virtualized applications with a goal of helping organizations virtualize tier-1 applications with confidence.

ESG Lab Testing

ESG Lab performed hands-on testing of virtualized application workloads in the Microsoft Enterprise Engineering Center (EEC) in Redmond, Washington. A high level overview of the test bed used during the ESG Lab validation follows:

Servers

An HP BL680C blade server was used to test Exchange 2010, SQL Server 2008 R2, and SharePoint 2010 application workloads virtualized with Hyper-V R2 SP1. Each server blade was populated with up to 24 processor cores and 128 GB of RAM. Microsoft Windows 2008 R2 SP1 Data Center Edition was installed on a pair of mirrored internal drives in each blade.
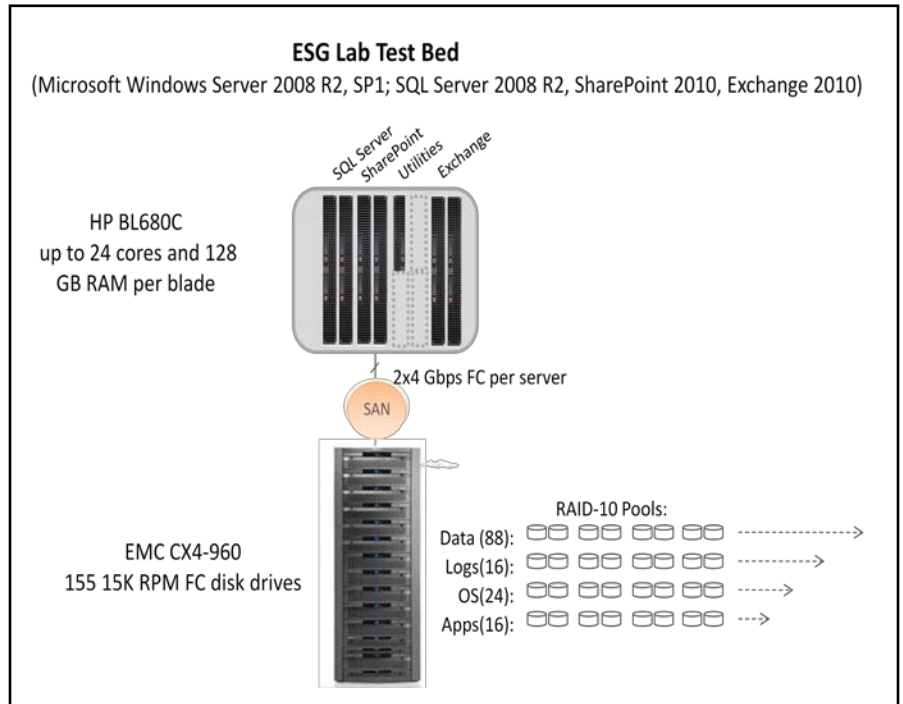
Storage

The blade server chassis was Fibre Channel SAN attached to an EMC CX4-960 disk array. Each of the servers had a pair of 4 Gbps Fibre Channel connections to the disk array. PowerPath version 5.2 was used for a multi-path connection between the servers and the disk array.

ESG Lab Test Bed
(Microsoft Windows Server 2008 R2, SP1; SQL Server 2008 R2, SharePoint 2010, Exchange 2010)

HP BL680C
up to 24 cores and 128
GB RAM per blade

2x4 Gbps FC per server

SAN

EMC CX4-960
155 15K RPM FC disk drives

RAID-10 Pools:
Data (88):
Logs(16):
OS(24):
Apps(16):

The disk array was populated with 155 15K RPM FC disk drives. Wide-striped RAID-10 pools were used to store virtualized application data, log data, operating system images, and application images. The application data pool was configured over 88 drives. Up to eight 700 GB data LUNs were configured and presented to each virtualized application server. All of the storage used by Hyper-V R2 SP1 virtual machines was configured as fixed virtual hard drives.
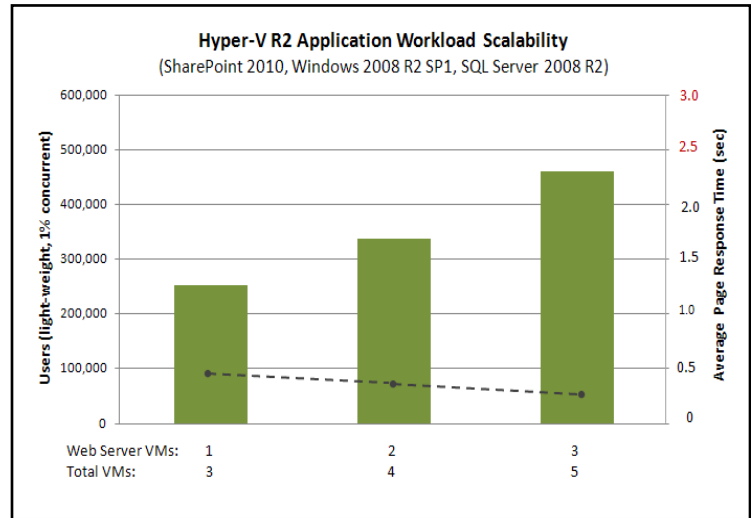
Virtualization

The servers used for virtualized application testing were rebooted after enabling the Hyper-V role that's built into the Windows Server operating system. Windows Server 2008 R2 SP1 was installed on a fixed virtual hard drive as a guest operating system for each virtual machine. A half-height blade was used for utilities including Active Directory (AD) and System Center Virtual Machine Manager (SCVMM).

SharePoint 2010

ESG Lab tested SharePoint 2010 collaboration software on a physical server with SharePoint roles running in three to five virtual machines. SharePoint roles (SQL Server back-end, web server front-end, and the SharePoint application) were configured to run in separate virtual machines. Testing was performed with one, two, and three web servers to assess the performance and scalability of SharePoint 2010 workloads running within a consolidated infrastructure powered by Hyper-V R2 SP1.

SharePoint and the web server VMs were configured with two virtual CPUs and 4 GB of RAM. The SQL Server 2008 R2 VMs were configured with 4 virtual CPUs and 32 GB of RAM. An F5 BIGIP Local Traffic Manager was used to load balance web server traffic with a round-robin scheduling algorithm.

Hyper-V R2 Application Workload Scalability
(SharePoint 2010, Windows 2008 R2 SP1, SQL Server 2008 R2)

| Web Server VMs: | 1 | 2 | 3 |
| Total VMs: | 3 | 4 | 5 |

Microsoft Visual Studio 2010 software was used to generate the SharePoint application workload. A non-blocking workload was tested with a goal of maximizing the stress on the Hyper-V R2 SP1 and SharePoint 2010 infrastructure. A 22 GB content database was tested with simulated users running a mix of light-weight SharePoint operations (89% browsing, 10% upload, 1% check-in/check-out). Visual Studio was installed and ran on a separate physical server with 24 CPU cores and 128 GB of RAM. A constant workload was tested with one, two, and three web servers.

Summary of Results

- As expected, CPU utilization of the front-end was the bottleneck during single web server VM testing.
- Adding web server VMs alleviated the CPU bottleneck.
- Adding web server VMs increased the number of 1% concurrent SharePoint users from 252,600 to 460,800.
- Average page response times improved as web servers were added.
- Average page response times were faster than the Microsoft-recommended guideline of 1-2 seconds.

Why This Matters

Microsoft's SharePoint suite has quickly attained must-have status for organizations with collaboration needs and large quantities of unstructured data. It is fulfilling an increasing need for global collaborative technology platforms and much of its success lies in the fact that it fundamentally focuses on business—not technology—objectives. Deploying SharePoint in a highly virtualized environment is therefore becoming essential to maintain focus on business process improvement and core company goals. SharePoint is quickly becoming a popular application for server virtualization: 46% of organizations surveyed already have it deployed in a virtualized environment and an additional 42% have plans for or interest in deploying it on a virtualized platform.
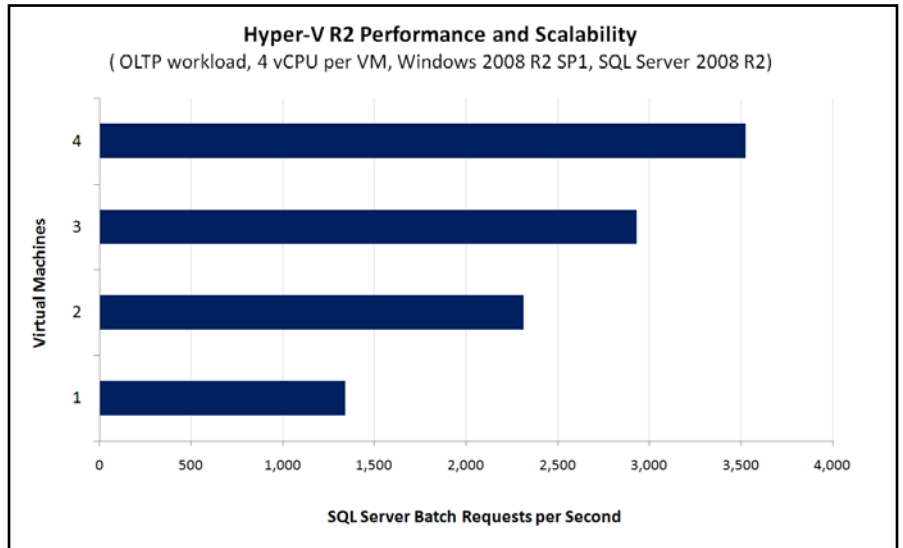
SharePoint's role as an enterprise collaboration platform calls for high availability and data mobility—two key capabilities provided by Microsoft Hyper-V R2 SP1. The immediate deployment of new SharePoint instances on virtual machines suggests that customers are recognizing these benefits.

ESG research and lab testing indicates that more recent SharePoint implementations have a much greater likelihood of being deployed on a virtualized server infrastructure, which suggests that server virtualization has reached a level of maturity that gives IT staffs confidence to leverage it in support of business-critical applications.

SQL Server 2008 R2

ESG Lab tested a multi-user online transaction processing (OLTP) workload on a physical server with SQL Server 2008 R2 database software running in one to four virtual machines. An online brokerage application was used to assess the performance, scalability, and manageably low virtualization overhead of SQL Server 2008 R2 workloads running within a consolidated infrastructure powered by Hyper-V R2 SP1.

Each SQL Server VM was configured with four virtual CPUs and 16 GB of RAM. A 20,000 customer database was configured within each virtual machine with a goal of scaling up to 80,000 customers during the four-VM test. Performance of a single VM virtualized with Hyper-V R2 SP1 was compared to the performance of the physical server configured with the Windows msconfig utility to use the same resources (4 CPU cores, 16 GB of RAM).

Hyper-V R2 Performance and Scalability
(OLTP workload, 4 vCPU per VM, Windows 2008 R2 SP1, SQL Server 2008 R2)

Virtual Machines vs *SQL Server Batch Requests per Second*

Summary of Results

- Hyper-V R2 SP1 on a single physical server was used to deploy virtualized SQL Server 2008 R2 databases for 20,000 through 80,000 OLTP customers.
- Aggregate performance scaled up to 3,526 SQL Server batch requests per second during the four-VM test.
- Average transaction response times remained low (under 150 milliseconds) as VMs were added.
- A single VM performed 12% less transactions per second compared to the physical server configured with the same amount of CPU and RAM.

Why This Matters

Database health is critical to business managers, application owners, and enterprise IT teams; the life of an organization literally resides in its database servers. Take away the ability to reliably run enterprise applications or complete customer transactions and watch business come to a standstill. For IT organizations supporting large numbers of users, hesitation to implement virtualization stems in part from the perception that virtualization adds performance overhead and won't allow performance to scale predictably, particularly when it comes to multi-user, business-critical applications relied upon by the majority of the business. In a recent ESG survey, 25% of respondents reported that performance issues were a leading factor preventing them from using virtualization more pervasively.
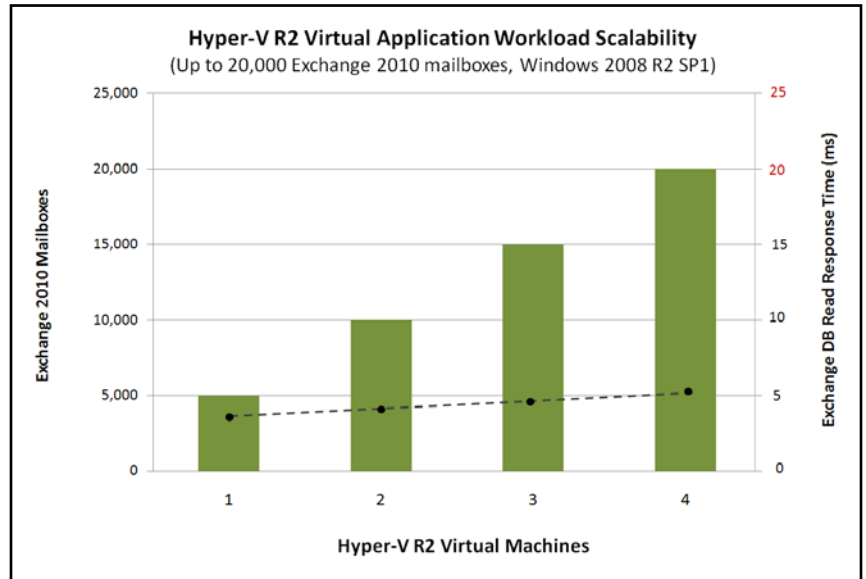
ESG Lab measured manageably-low fixed VHD and virtualized application overhead in a Hyper-V environment. This relatively minor performance impact is easily justified given the compelling consolidation, manageability, and cost saving benefits that can be achieved with Hyper-V R2 SP1; especially given the continuously improving performance of SQL and industry standard server hardware.

ESG research further validates the value of deploying SQL in a virtualized environment, with 39% of respondents having already deployed tier-2 database applications (i.e., Oracle Standard, Microsoft SQL, MySQL, etc.) and an additional 49% having plans or interest in deploying on production virtual machines.

Exchange 2010

ESG Lab validated the IO performance scalability of a Hyper-V R2 SP1 virtualized Exchange environment with the Microsoft Exchange Server Jetstress 2010 utility running in one to four virtual machines deployed on a single physical server. ESG Lab audited the results of Exchange Tested Solutions performed by Microsoft and participating server vendors to confirm that Exchange 2010 solutions fully virtualized with Hyper-V R2 SP1 can scale to meet application level performance and scalability requirements in highly available multi-site deployments.

Jetstress testing was performed with 5,000 250 MB mailboxes stored in two databases with two copies per virtual machine. Jetstress generated 0.15 IOs per second of Exchange traffic per mailbox.

Hyper-V R2 Virtual Application Workload Scalability
(Up to 20,000 Exchange 2010 mailboxes, Windows 2008 R2 SP1)

Summary of Results

- A single server virtualized with Hyper-V R2 SP1 scaled to meet the IO performance requirements of 20,000 Exchange 2010 mailboxes. Exchange database read response times remained well below Microsoft's recommended maximum of 20 milliseconds as VMs were added.
- Exchange Tested Solutions that were fully virtualized with Hyper-V R2 SP1 met the scalability and performance requirements of 9,000 through 32,000 highly available Exchange 2010 mailboxes.
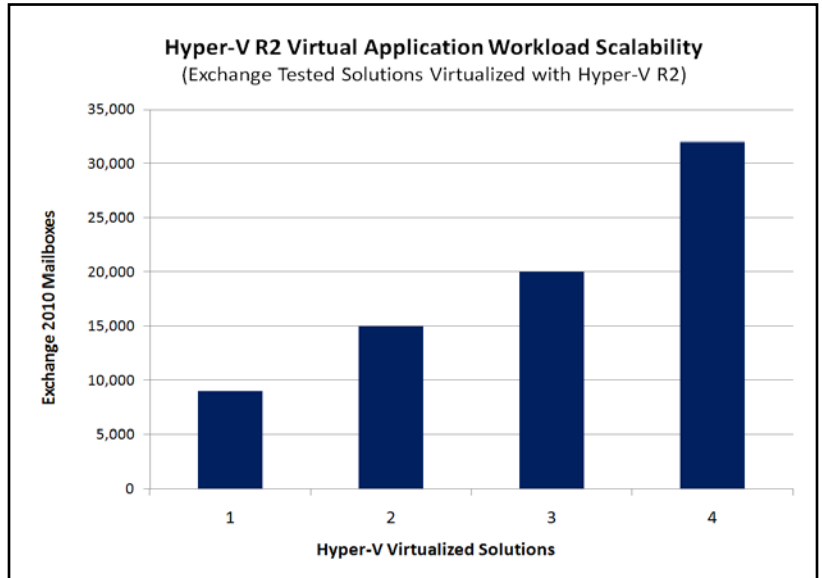
Why This Matters

IT executives treat Microsoft Exchange as one of the most critical applications they support, constantly balancing availability with cost effectiveness. It has become a lifeline for many businesses, functioning as the primary means of communication, collaboration, and business workflow. Microsoft Exchange 2010 introduced a new highly scalable multi-tiered architecture that fits well with corporate IT objectives around IT consolidation and streamlined operations.

Gaining confidence with server virtualization, businesses are now ready—and willing—to move their next tier of applications and IT services, including e-mail, to virtualized environments. Hyper-V R2 SP1 gives administrators deployment flexibility, simplified administration, reduced hardware costs, and the ability to improve service levels. IT organizations can also leverage Hyper-V technology, at no additional expense, to create a test environment that will help them test and plan for a highly successful migration and decrease the time required to move from pilot to production.

ESG Lab has confirmed that the performance, scalability, and low overhead of Hyper-V R2 SP1 can be used to reduce costs and improve the manageability and flexibility of consolidated Exchange 2010 environments.

ESG Lab Highlights

- A single server hosting a SharePoint 2010 infrastructure fully virtualized with Hyper-V R2 SP1 supported up to 460,800 light-weight 1% concurrent users.
- A single server hosting a virtualized SQL Server 2008 R2 infrastructure deployed within four Hyper-V virtual machines supported up to 80,000 simulated OLTP customers.
- A single Hyper-V R2 SP1 enabled server scaled to meet the IO performance requirements of 20,000 Exchange 2010 mailboxes.
- Exchange Tested Solutions (ETS) tested by Microsoft and its partners in a fully virtualized Hyper-V R2 SP1 environment met the performance requirements of 9,000 through 32,000 highly available Exchange 2010 mailboxes.

- Manageably-low Hyper-V overhead of 12% was recorded during SQL Server testing when comparing the performance of a physical server to a single VM configured with same number of virtual CPU cores and the same amount of RAM.

The Bigger Truth

Respondents to a recent ESG survey indicated that increasing the use of virtualization was their number one IT priority over the last two years and will continue to be the top priority for the next 12-18 months. While server virtualization penetration continues to gain momentum, IT organizations still have numerous hurdles to overcome in order to deploy it more widely and move closer to a 100% virtualized data center. ESG found that 59% have yet to employ virtualization where it will provide the most benefit: their mission-critical tier-1 applications. For IT organizations supporting large numbers of users, hesitation to implement virtualization stems from the perception that it adds performance overhead and unpredictable scalability and availability to the tier-1, multi-user, business-critical applications relied upon by the majority of their users. Testing performed by ESG Lab and Microsoft with its server and storage vendor partners has confirmed that Microsoft Hyper-V R2 SP1 technology can be used to meet the performance and scalability requirements of virtualized tier-1 application workloads including Microsoft Exchange 2010, Microsoft SQL Server 2008 R2, and SharePoint 2010.

Microsoft provides virtualization solutions from the desktop, to the data center, to the cloud. Choosing to virtualize tier-1 data center applications with Hyper-V enables businesses to leverage the built-in architecture of Windows Server 2008 with Hyper-V R2 SP1 to increase availability, improve agility, and overcome scalability and performance concerns. IT organizations can lower costs with built-in hypervisor support and benefit from existing skill sets to automate and monitor their environments using tools with which their staff are already familiar. Administrators also benefit by avoiding complicated support models and, although not extensively highlighted within this report, they should also consider the value of using Microsoft System Center as a management tool for both physical and virtual environments. Hyper-V technology provides increased deployment options, increased resource utilization, enhanced business continuity, and a more efficient IT operating environment.

Put it all together and it's clear that Hyper-V R2 SP1, included at no additional charge in Microsoft Server 2008 R2 SP1, can be used to virtualize tier-1 data center applications with confidence.

Learn more at www.microsoft.com/virtualization