

# Lab Validation Report

## Microsoft Windows Server 2012 with Hyper-V and SharePoint 2013

Virtualizing Tier-1 Application Workloads with Confidence

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### ESG Lab Reports

The goal of ESG Lab reports is to educate IT professionals about data center technology products for companies of all types and sizes. ESG Lab reports are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objective is to go over some of the more valuable feature/functions of products, show how they can be used to solve real customer problems and identify any areas needing improvement. ESG Lab's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments. This ESG Lab report was sponsored by Microsoft.

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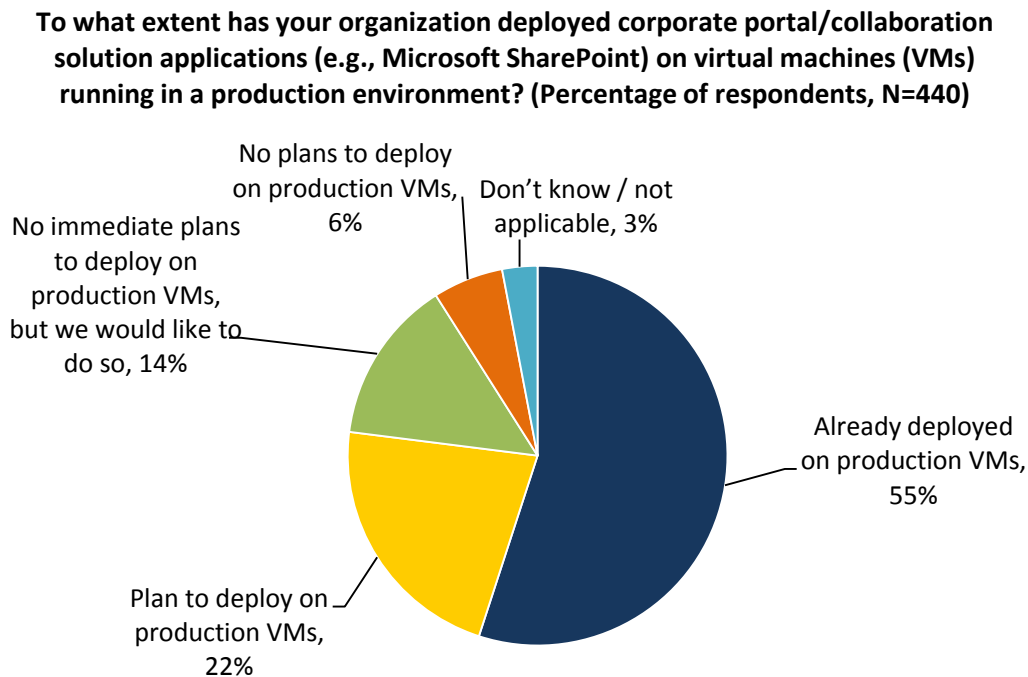
## Introduction

This ESG Lab report documents the results of independent, hands-on testing of the performance, scalability, and efficiency of Microsoft's Windows Server 2012 with improved Hyper-V virtualization. ESG Lab tested with a tier-1 virtualized SharePoint 2013 application workload to confirm that Hyper-V can be used to increase scalability and maintain high levels of enterprise-class performance.

### Virtualized SharePoint Deployments

Many organizations are reaping the benefits of server virtualization, including lower IT capital and operational costs; greater IT efficiency; and improved application provisioning, maintenance, availability, and backup/recovery processes. As administrators gain confidence in virtualization technologies, they strive to improve agility and enhance the availability of IT services. According to a recent ESG survey of 440 organizations using server virtualization technology, more than half (55%) had already deployed corporate portal/collaboration solution applications (i.e., Microsoft SharePoint) on production-based VMs, with 22% planning to in the near future (see Figure 1).<sup>1</sup>

Figure 1. Production Environment Virtualized SharePoint Deployments



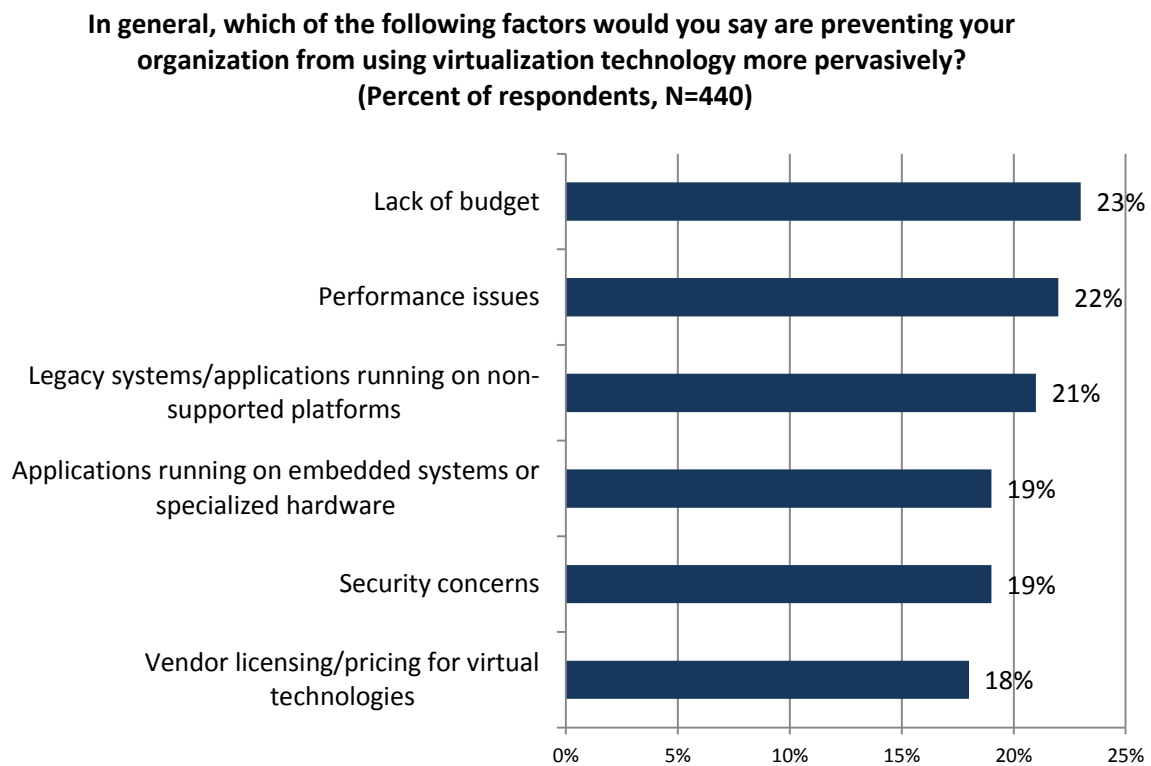
Source: Enterprise Strategy Group, 2013.

For the more mature organizations surveyed that have deployed and are currently deploying virtualized database applications, uptime and performance are the two most important metrics in gauging the success of their virtualization deployments. Many of these early adopters have now virtualized entire infrastructures, including business-critical tier-1 applications such as Microsoft SharePoint. In other words, application performance is a top criterion for virtualization success that is being addressed by the early adopters who have fully embraced server virtualization.

<sup>1</sup> Source: This data comes from a custom research project conducted by ESG on behalf of Microsoft on the topic of virtualization and private cloud trends in May 2012. All other ESG research references in this lab report come from this research project, unless otherwise noted.

As organizations move toward being 100% virtualized, the performance, scalability, and reliability requirements of mission-critical tier-1 applications can inhibit virtualization growth. ESG research confirms that hesitation: According to research conducted with IT professionals, 59% of organizations have not yet virtualized their tier-1 applications, citing performance as a major reason. ESG additionally asked respondents which factors were preventing their organizations from using virtualization technology more pervasively. As Figure 2 shows, the key concerns were budget and performance; of the 440 respondents, 23% stated that lack of budget was a factor, while 22% remain concerned with performance issues.

*Figure 2. Top Factors Preventing More Pervasive Virtualization Technology Usage*



*Source: Enterprise Strategy Group, 2013.*

In addition to performance, multi-user applications present some other challenging questions for virtualization users, such as:

- Will the virtualized infrastructure scale as our needs grow?
- Can we ensure that performance SLAs for virtualized business-critical applications will be met?

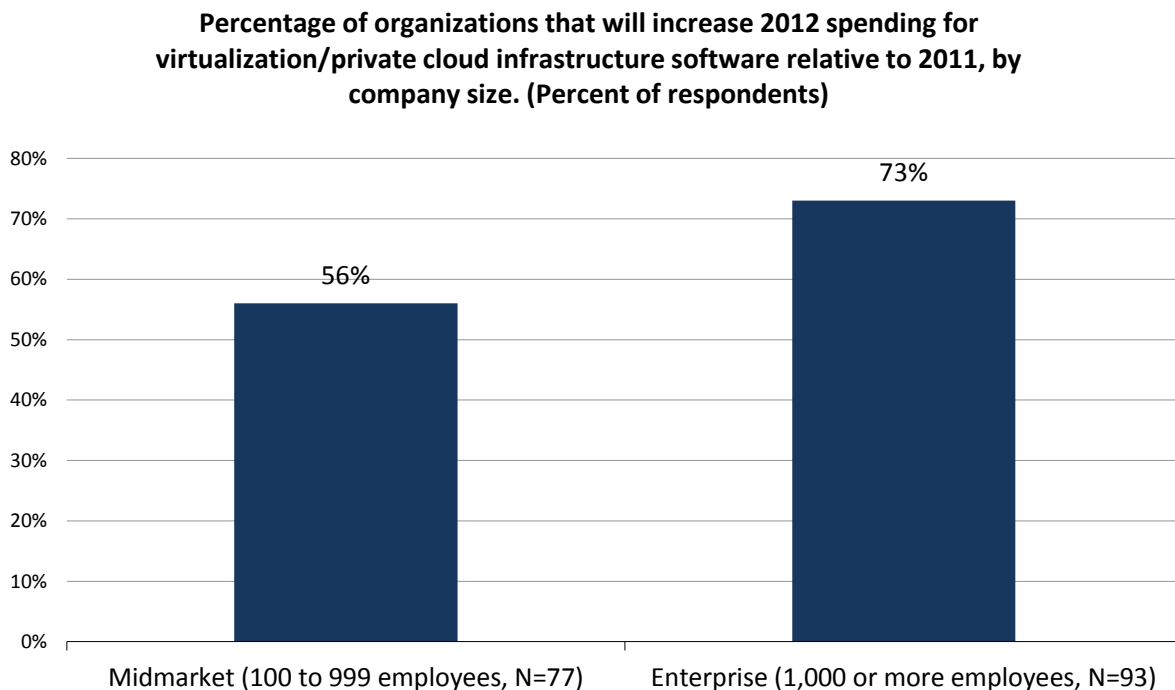
Despite these virtualization challenges, experienced organizations with more mature virtualization deployments are rapidly moving beyond the initial benefits of consolidation, finding that more extensive use of virtualization can help improve application backup/recovery, bolster application availability, and automate IT processes. They have come to realize that the critical metrics in a virtual environment are those focused on availability and performance, and they measure the success of their virtualization efforts not only by their ability to reduce costs and increase efficiency, but also by their ability to meet application performance requirements. Because the benefits of virtualization are extremely compelling, ESG expects to see an increasing number of organizations looking for ways to leverage the technology for their tier-1 applications.

## Overcoming Virtualization Concerns

Businesses continue to embrace the value of server virtualization and show a steady rate of virtualization adoption, increased production use, and improved consolidation ratios. Sixty one percent of respondents have greater than 50% of their organization's x86 servers virtualized. Sixty three percent of respondents have between 21% and 60% of their virtual machines running in a production environment. Fifty one percent have more than ten virtual machines per physical server. While these indicators continue to increase, the research also reveals that the majority (61%) of deployments have 500 or less virtual machines.

Figure 3 shows the results of a recent ESG survey that asked respondents to identify the extent to which their organizations' 2012 spending for virtualization/private cloud infrastructure software will change relative to 2011. More than half (56%) of midmarket organizations expect their 2012 spending levels for virtualization technology to increase, while nearly three-quarters (73%) of their enterprise counterparts anticipate higher budget allocations for the technology compared with 2011. The consistent increases in budgetary funds allocated for virtualization spending reflect the continued growth in both usage and adoption as organizations—regardless of size—look to take advantage of the benefits offered by the technology.<sup>2</sup>

*Figure 3. 2012 Virtualization Spending Increases by Company Size*



*Source: Enterprise Strategy Group, 2013.*

<sup>2</sup> Source: ESG Research Report, [2012 IT Spending Intentions Survey](#), January 2012.

## Microsoft Windows Server 2012 with Hyper-V

Microsoft's Windows Server 2012 offers customers new functionality designed to optimize virtualization and cloud computing while capitalizing on existing investments. Understanding the opportunities and challenges that consolidation, virtualization, and cloud computing offer, Microsoft has built numerous enterprise-level features into this operating system for organizations and service providers of all kinds. At a high level, these features will help customers to:

- Build private clouds and leverage cloud services that can scale easily while minimizing security risks.
- Manage infrastructure efficiently with maximum uptime, so that businesses can leverage the power of many servers with the simplicity of one.
- Build open, scalable web platforms that support geography-spanning applications.
- Support today's business environments that require "anytime, anywhere" information access, regardless of the infrastructure, network, device, or application they choose for access.

Hyper-V in Windows Server 2012 provides organizations with massive scalability to transform data centers into a complete cloud platform. Hyper-V greatly expands support for resource allocation, now supporting up to 64 virtual processors and 1TB of memory for virtual machines. Other new features related to virtualization include:

- *Virtual Fibre Channel (FC) Support* – Providing direct connections to FC host bus adapter (HBA) and SAN fabric from Hyper-V virtual machines for higher performance and availability.
- *Live storage migration* – Supporting workload uptime while moving virtual hard disks between hosts.
- *Shared Nothing Live Migration* – seamlessly move running virtual machines, and their underlying storage between hosts that share nothing but an ethernet cable
- *Guest NUMA* – Virtual processors and guest memory are grouped into virtual NUMA nodes and the virtual machine presents a guest topology based on the underlying physical topology of compute and memory resources. With guest NUMA, the guest workloads can use their knowledge of NUMA and self-optimize based on this data. It ensures that the guest operating system creates optimal mapping between virtual and physical resources which in turn makes certain that guest operating systems and applications can achieve the most efficient execution, best performance, and most linear scale.
- *SR-IOV Networking* – Introduces a new high-throughput, low-latency networking solution that surfaces a portion (a virtual function) of a physical NIC within a virtual machine and that can deliver >10GB performance without sacrificing key mobility features like Live Migration.
- *New VHDX Format* – Support for up to 64TB of virtual hard disk capacity; built-in resiliency; and an additional 4KB logical sector to improve performance for certain workloads and applications.

Combined, these new features help ensure that virtualized infrastructures support the configuration of large, high-performing virtual machines to sustain enterprise-level workloads that meet the scalability needs of all-sized organizations.

## Microsoft SharePoint 2013

Microsoft SharePoint 2013 is a collaboration software solution that helps simplify business intelligence, content management, search, and sharing for intranet and internet sites. Enhancements to Microsoft SharePoint 2013 that increase the performance, scalability, and usability of an organization's collaboration services are listed below.

- **Share** ideas and find answers, while keeping track of what colleagues are working on through new social features. Now, every Office application allows users to publish content to SharePoint and easily share with anyone inside or outside of your organization, all while updating activity feeds and keeping in touch on the go with mobile phone and tablet support.
- **Organize** everything that's being worked on and get visibility into upcoming deadlines with integration to Outlook and Microsoft Project. New team sites can be created quickly to bring every document needed into one place for a working group to collaborate with. Using SkyDrive Pro, content can be synced from SharePoint to a desktop, providing access even when offline.
- **Discover** people across an organization with common interests through past projects and documents worked on together. Publish interactive reports from Excel 2013 to SharePoint to gain insight and share answers with colleagues. Get recommendations on which people and documents to follow based on customized searches that deliver more relevant results.
- **Build** web applications with technologies like JavaScript and HTML with the new Cloud App Model for SharePoint. Make the applications available to anyone through the SharePoint store, whether through the public store or freely shared through the corporate catalog. Intranet and internet sites can be created using familiar tools and an organization's vision can be shared with everyone.
- **Manage** costs, risk, and time with the latest scale, performance, and management capabilities. By running SharePoint in the cloud with Office 365, infrastructure costs get reduced significantly, while new archiving, e-discovery, and case management get extended across SharePoint, Exchange, and Lync.

## F5 Networks BIG-IP Local Traffic Manager

With over 15 years of technology developed specifically for providing the highest levels of security, performance, and availability for applications like SharePoint, F5 has pioneered the application delivery space with its BIG-IP family of products. With its integrated L3-L7 firewall & reverse proxy engine, the BIG-IP has expanded its role as the SharePoint load balancer to include being the perimeter security device as well. For more information, please reach out to [msfttechteam@f5.com](mailto:msfttechteam@f5.com).

## ESG Lab Validation

ESG Lab performed hands-on testing of a virtualized tier-1 application workload in Redmond, Washington. Testing was designed to demonstrate how Windows Server 2012 with Hyper-V and SharePoint 2013 offer a highly scalable virtualized solution.

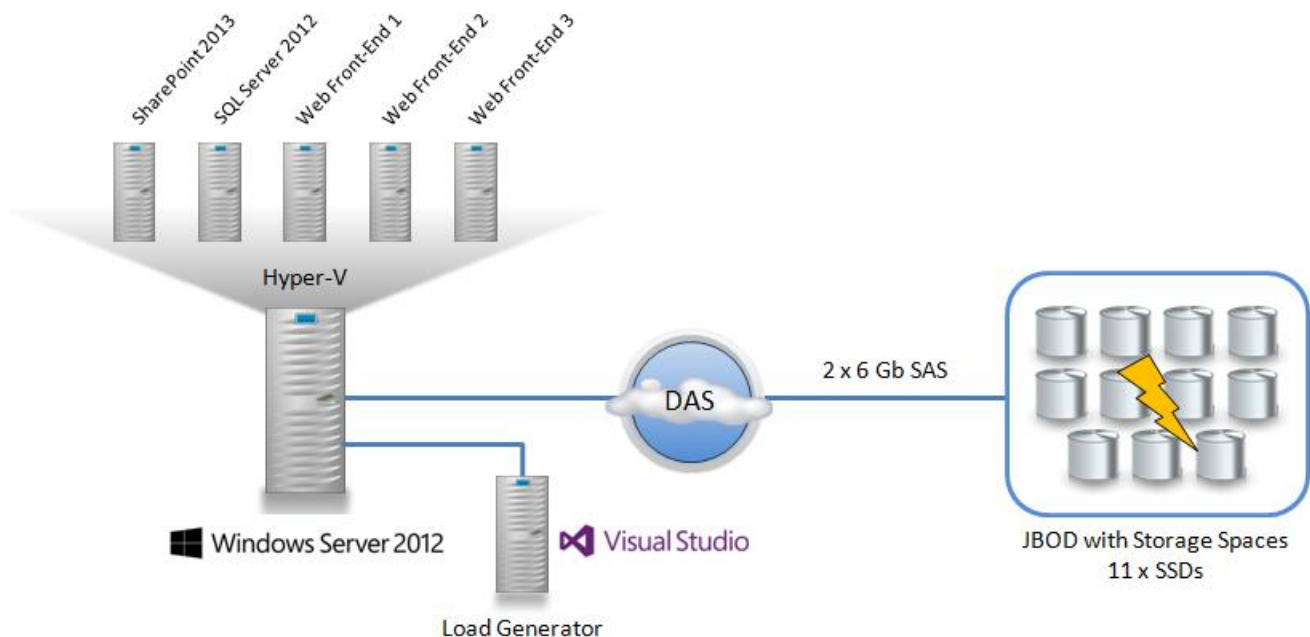
### Getting Started

The workload used during ESG Lab testing was designed to simulate thousands of SharePoint users performing typical collaboration activities on a corporate intranet site. SharePoint roles (SQL Server back-end, SharePoint web server front-end, and the SharePoint application server) were configured to run in separate virtual machines. Testing was performed with one, two, and three web front-end servers (WFEs) to assess the performance and scalability of SharePoint 2013 workloads running within a consolidated infrastructure powered by Windows Server 2012 with Hyper-V.

Microsoft Visual Studio 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 and SharePoint 2013 infrastructure. A 2.29TB physical storage pool was created with a 108GB mirrored storage space for the virtual disk containing the content database. The database was tested with a constant load pattern running a mix of lightweight SharePoint operations (89% browsing, 10% upload, 1% check-in/check-out). Visual Studio and accompanying test agents were installed in virtual machines on a separate physical server with 16 CPU cores (32 logical processors) and 128GB of RAM. A constant workload was tested with one, two, and three web servers.

An overview of the test bed used during ESG Lab testing is depicted in Figure 4. A Quanta QSSC-S4R server with 40 CPU cores (80 logical processors), 224GB of RAM, and Windows Server 2012 with Hyper-V was configured with five virtual machines: A SharePoint virtual machine was configured with 2 vCPUs and 4GB of RAM, a SQL Server virtual machine was configured with 24 vCPUs and 64GB of RAM, and three SharePoint web front-ends were configured with 8 vCPUs and 12GB of RAM. The server was connected via 6Gb SAS direct-attached storage (DAS) to a JBOD of 11 solid-state drives (SSDs). Fixed-size virtual hard disks, containing the Windows Server 2012 guest operating systems, SharePoint SQL Server data, and web server data were stored on mirrored storage spaces within the same 2.29TB physical storage pool. An F5 Networks BIG-IP Local Traffic Manager was used to load balance web server traffic with a round-robin scheduling algorithm.

Figure 4. ESG Lab Test Bed

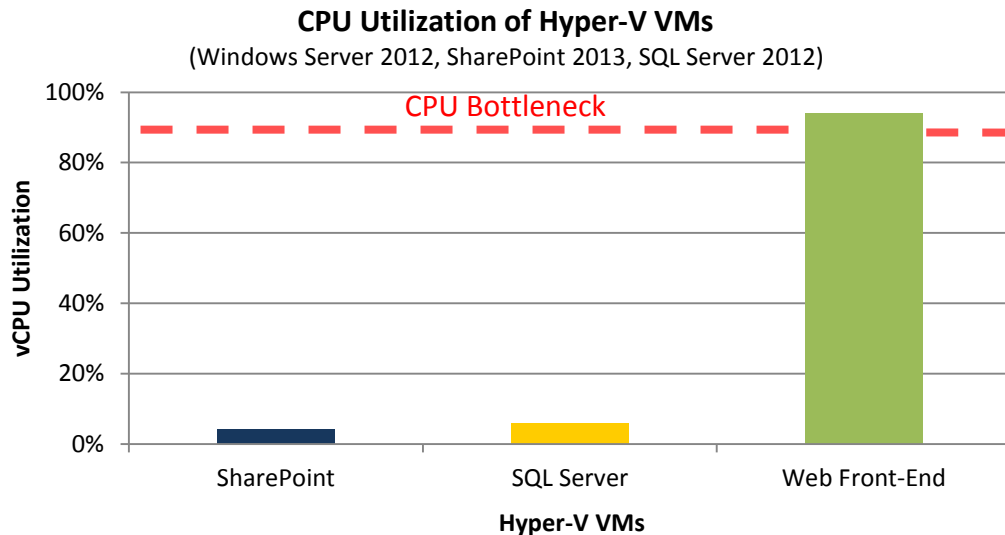




## Scalability

A constant workload was tested with simulated users performing lightweight SharePoint operations as quickly as possible (a.k.a., non-blocking). Virtual machine CPU utilization (vCPU) was monitored as the busy SharePoint workload was tested with three VMs. The results of the three-VM test with a single web server are summarized in Figure 5.

Figure 5. SharePoint 2013 Virtual CPU Utilization



### What the Numbers Mean

- The front-end web server role has a CPU bottleneck which limits the number of SharePoint users that the virtualized infrastructure can support.
- The SharePoint and SQL Server virtual machines are under-utilized from a virtual CPU perspective compared to the web server.

Load-balanced web server VMs were added to the virtualized SharePoint deployment with a goal of alleviating the web front-end CPU resource bottleneck. This also helped to better utilize the SharePoint and SQL Server virtual machines. The results are shown in Figure 6 and Table 1.

Figure 6. SharePoint 2013 Virtual CPU Utilization

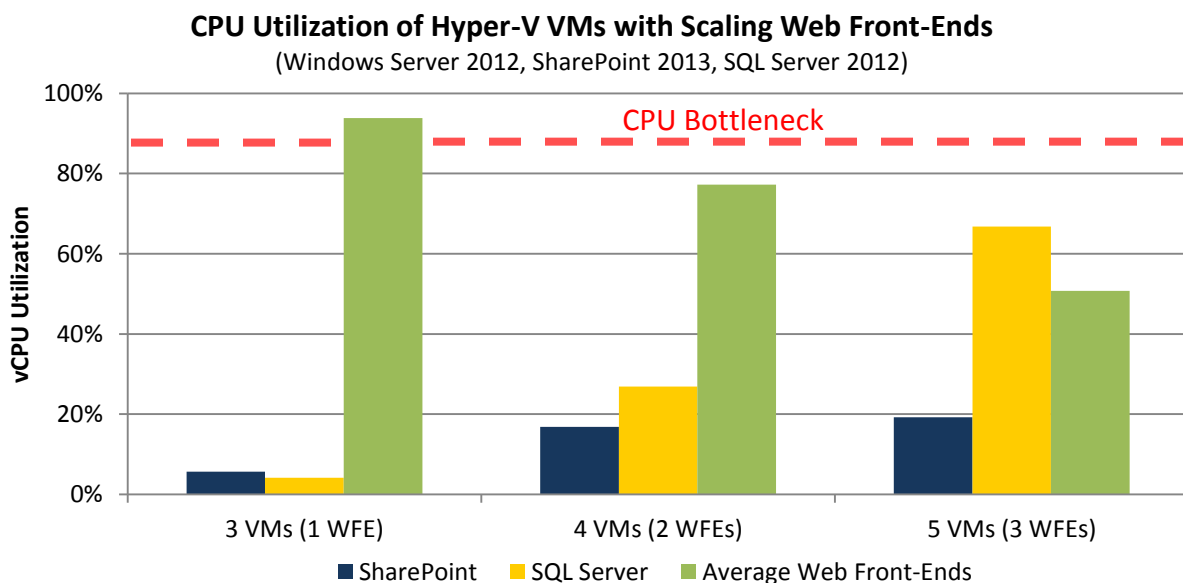


Table 1. SharePoint 2013 Virtual CPU Utilization

		vCPU Utilization		
Total VMs	Total WFE VMs	SharePoint	SQL Server	Average Web Front-Ends
3	1	6%	4%	94%
4	2	17%	27%	77%
5	3	19%	67%	51%

**What the Numbers Mean**

- Adding web server VMs alleviated the front-end CPU bottleneck.
- As more WFEs were added to the deployment, SharePoint and SQL Server became better utilized.
- The average WFE vCPU utilization was reduced by 46% when scaling from one to three virtualized WFEs.

**Why This Matters**

Multi-tier applications often have tiers with dramatically different resource requirements and are therefore a great candidate for server virtualization and consolidation. Tiers with low resource utilization (e.g., a SharePoint application VM) can be consolidated on a single server to reduce costs. Tiers with high resource utilization can also be optimized with virtual server technology.

The flexibility of a virtual server infrastructure makes it easy to add resources within an existing virtual machine (e.g., add a virtual CPU core to the SharePoint SQL Server database) or add resources within another virtual machine (e.g., add a virtualized front-end web server to a SharePoint farm). Tiers with extremely burdensome resource requirements can also be deployed on a separate physical server (e.g., a SQL Server database for a very large SharePoint farm).

## Highly-performing

As ESG Lab scaled the number of web front-ends to alleviate the vCPU bottleneck, requests per second (RPS) and the average page response times were recorded as the busy SharePoint workload was serviced by the growing number of Hyper-V virtual machines. The number of requests per second that could be sustained while keeping end-user response times under a generally acceptable limit was used to calculate the number of 1% concurrent users that the virtualized infrastructure could support based on Microsoft performance and capacity planning guidelines.<sup>3</sup> The results are highlighted in Figure 7 and Table 2.

Figure 7. SharePoint 2013 Hyper-V Workload Scalability

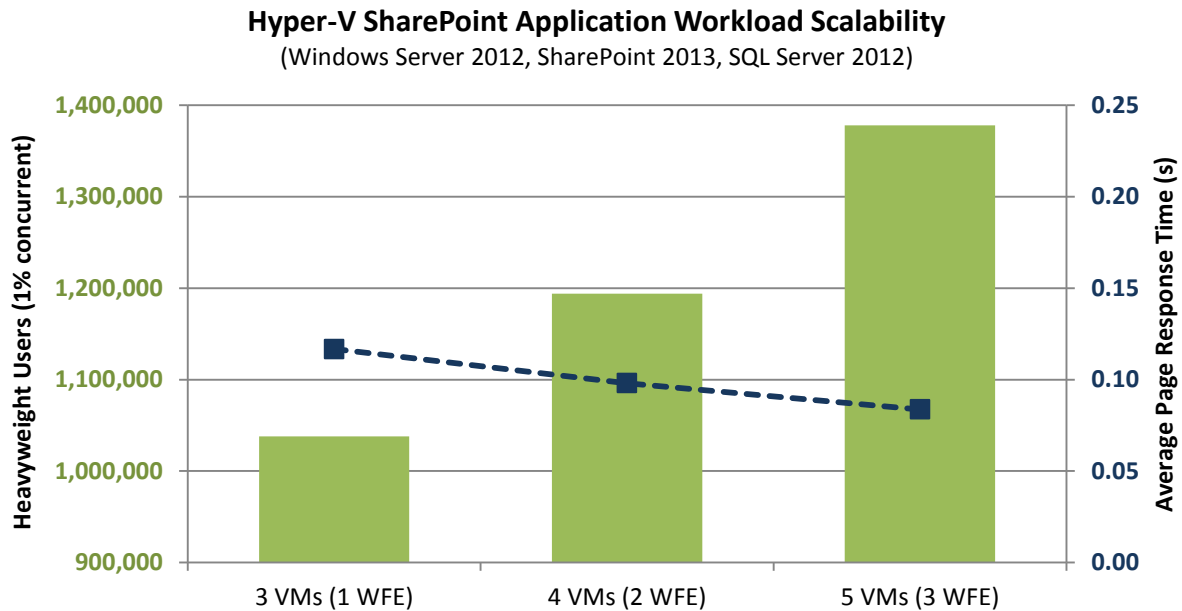


Table 2. SharePoint 2013 Hyper-V Workload Scalability

Total VMs	Total WFE VMs	Requests/sec	Concurrent User Count	Average Page Response Time (s)
3	1	173	1,038,000	.12
4	2	199	1,194,000	.10
5	3	230	1,378,000	.08

### What the Numbers Mean

- The number of heavyweight 1% concurrent users on a SharePoint farm deployed on a single physical server increased from 1,038,000 to 1,378,000 as WFE VMs were added.
- 75% scaling efficiency was achieved as each WFE VM was added to the existing deployment.<sup>4</sup>
- Average page response times improved as the WFE VMs were added and remained well under the generally accepted response time limit of three seconds.

<sup>3</sup> # users (with 1% concurrency) = seconds per hour / request per hour / concurrency% \* requests per second  
[http://technet.microsoft.com/en-us/library/cc261795\(office.12\).aspx](http://technet.microsoft.com/en-us/library/cc261795(office.12).aspx)

<sup>4</sup> Based on a comparison of requests per second divided by average page response time.

ESG Lab used the three WFE virtualized SharePoint deployment to scale the application workload with a goal of achieving the maximum number of concurrent users. ESG Lab used a Visual Studio constant load pattern of 20 and continued to increase that by ten until the average vCPU utilization of the three WFEs reached just below 90%. The constant load pattern represents the number of load test users, not to be confused with simulated SharePoint application users. By increasing the number of load test users, the number of requests/sec increases. This helps identify how much load the system can take before starting to regularly exceed the thresholds that should be maintained in a healthy SharePoint farm.<sup>5</sup> The impressive results are shown in Figure 8 and Table 3.

Figure 8. SharePoint 2013 Hyper-V Workload Scalability

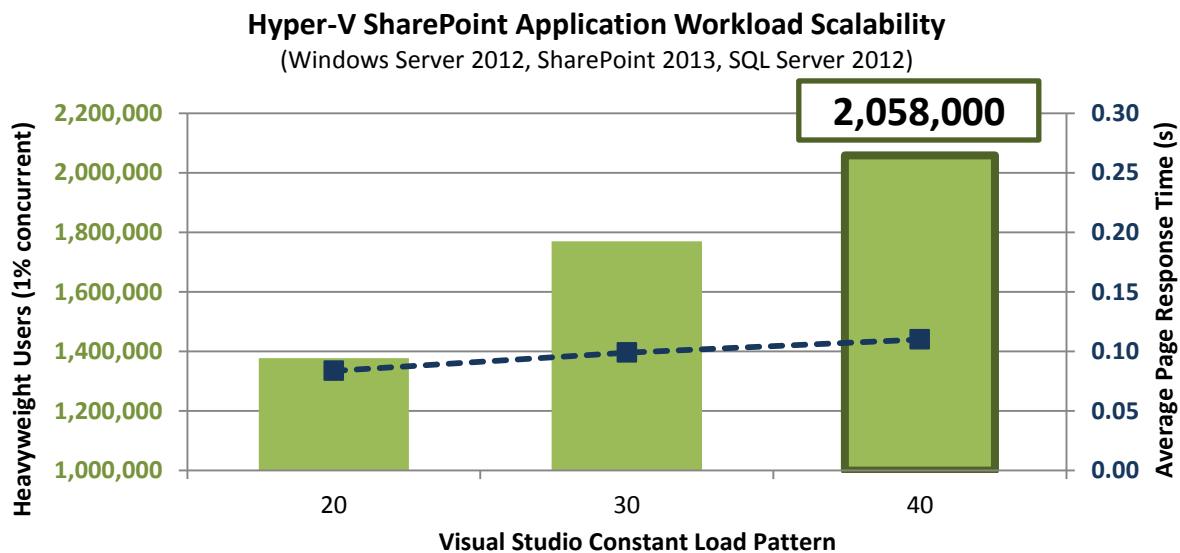


Table 3. SharePoint 2013 Hyper-V Workload Scalability

Visual Studio Constant Load Pattern	Requests/sec	Supported Concurrent User Count	Average Page Response Time (s)	Average WFE vCPU Utilization
20	230	1,378,000	0.08	51%
30	295	1,770,000	0.10	73%
40	343	2,058,000	0.11	86%

#### What the Numbers Mean

- For a constant load pattern of 40 and a three WFE vCPU utilization average of just under 90%, over two million concurrent users were supported in a virtualized SharePoint deployment.
- A scaling efficiency of between 90-95% was achieved as the constant load pattern continued to increase by ten from 20-40 before a WFE vCPU bottleneck was reached.
- Average page response times remained manageably low and well under the generally accepted response time limit of three seconds as the three WFE VMs were pushed to peak performance.

<sup>5</sup> For more information regarding constant load pattern with Visual Studio - <http://technet.microsoft.com/en-us/library/ff758659.aspx>

## ***Why This Matters***

Microsoft's SharePoint suite has quickly attained must-have status for organizations with collaboration requirements and large quantities of unstructured data. It is fulfilling an increasing need for global collaborative technology platforms and much of its success is due to its fundamental focus on business—not technology—objectives. Deploying SharePoint in a highly virtualized environment is therefore becoming essential to maintaining focus on business process improvement and core company goals.

ESG Lab confirmed that the Windows Server 2012 with Hyper-V can be used to easily consolidate a tier-1 SharePoint application workload with confidence. A single server hosting a virtualized SharePoint 2013 infrastructure was deployed within five Hyper-V virtual machines and supported up to 2,058,000 simulated SharePoint 2013 users. The average number of supported users increased by just over 20% and response times remained low as the constant load pattern increased from 20 to 40.

## ESG Lab Validation Highlights

- ☑ A SharePoint 2013 infrastructure deployed within five Windows Server 2012 Hyper-V virtual machines, running on a single physical server, supported up to 2,058,000 simulated users on a single physical server.
- ☑ As expected, the front-end web server was the bottleneck during testing with a single virtual machine servicing common SharePoint 2013 Internet Information Services (IIS) requests.
- ☑ Adding web server VMs improved response times, increased the number of simulated users that the virtualized infrastructure could support, and better utilized the SharePoint and SQL Server applications.

## Issues to Consider

- ☑ Capacity planning and performance analysis of existing SharePoint deployments is recommended to not only determine whether your organization's workload is suitable for virtualization, but also to plan the processor, memory, and network resources that need to be configured within each virtual machine.
- ☑ SharePoint application and web server roles are good candidates for virtualization. For larger deployments, consider deploying resource-bound SQL Server and index roles on physical servers.
- ☑ The test results presented in this report are based on benchmarks deployed in a controlled environment. Due to the many variables in each production data center environment, capacity planning and testing in your own environment is recommended.
- ☑ As expected after any benchmark test of this magnitude, analysis of the results indicates that tuning would probably yield slightly higher absolute results. Given that the goal of this test was not to generate a big number, ESG Lab is confident that the results presented in this report demonstrate the performance and scalability of tier-1 application workloads running in a consolidated Windows Server 2012 Hyper-V environment.

## The Bigger Truth

The increasing global adoption of—and importance attached to—Microsoft SharePoint reflects a number of current business realities driving a growing need for these types of collaboration technologies. “Follow the sun” research and development efforts need consistent information access and workflows on a global scale. Increased time-to-market pressures require constant and cost-effective collaboration between far-flung project teams. Even organizations looking to decrease costs by increasing use of contractors or encouraging work-at-home programs to reduce real estate requirements can effectively use collaboration platforms to seamlessly integrate these types of distributed workers into the organization.

SharePoint's role as an enterprise collaboration platform calls for high availability and data mobility, which are two key capabilities provided by server virtualization technology. The growing number of organizations deploying new SharePoint instances on virtual machines suggests that IT managers recognize these benefits. 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.

It isn't unusual for organizations to focus server virtualization efforts on consolidation until they build the confidence and expertise to consider the next tier of applications; ESG found that 59% of respondent organizations 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.

While these performance concerns are certainly understandable, ESG has found that the latest Windows Server 2012 Hyper-V virtualization technology has gone a long way to address those concerns. Modern multi-core processors now come with built-in acceleration for virtualization. Modern hypervisor software has now become increasingly efficient, fast, and scalable. In addition, Microsoft has developed a set of application-specific best practices and blueprints to provide proven performance scalability.

ESG Lab's hands-on testing has confirmed that Microsoft Windows Server 2012 with Hyper-V technology can be used to meet the performance and scalability requirements of virtualized tier-1 Microsoft SharePoint 2013 application workloads. Predictably low response times and excellent performance scalability were achieved during ESG Lab testing as a single server hosting a virtualized SharePoint 2013 infrastructure was deployed within five Hyper-V virtual machines. Adding web server virtual machines alleviated a CPU bottleneck, improved response times, and increased throughput as Hyper-V was used to consolidate up to 2,058,000 simulated SharePoint users on a single physical server.

Virtualizing Microsoft SharePoint application workloads with Hyper-V enables businesses to overcome scalability and performance concerns as they lower costs and increase the agility and availability of a consolidated IT infrastructure. With the latest version of Microsoft Hyper-V in Windows Server 2012, IT organizations can lower costs and benefit from existing skill sets using tools with which their staff is already familiar, which helps administrators avoid complicated support models.

Put it all together and it's clear that Windows Server 2012 with Hyper-V can be used to virtualize Microsoft SharePoint 2013 workloads with confidence while achieving impressive performance scalability.

## Appendix

Table 4. ESG Lab Test Bed

Software	
Hypervisor	Windows Server 2012 with Hyper-V
Native O/S	Windows Server 2012
Guest O/S	Windows Server 2012
Database	Primary Database—Microsoft SQL Server 2012 Load-generator Database—Microsoft SQL Server 2012
Physical Server	
Main Hyper-V	Quanta QSSC-S4R 4 x 10 Core CPU with hyper-threading for 80 logical processors with 224GB RAM
Load Generator	Dell R620 2 x 8 Core CPU with hyper-threading for 32 logical processors with 128GB RAM
Virtual Machines and Storage	
SharePoint Application	Two vCPUs and 4GB RAM, 60GB fixed VHDx
SQL Server for SharePoint	24 vCPUs and 64GB RAM 100GB fixed VHDx for OS, 100GB fixed VHDx for Database and Logs
Web Front-Ends x 3	Eight vCPUs and 12GB RAM, 60GB fixed VHDx
Visual Studio	Eight vCPUs and 12GB RAM, 60GB fixed VHDx
VS Workload Generators	Eight vCPUs and 8GB RAM, 60GB fixed VHDx
DAS JBOD Storage	
Main Hyper-V	11 x 213GB SSDs, 2 port 6Gb SAS, 2.29TB storage pool, four storage spaces
Load Generator	16 x 214GB SSDs, 2 port 6Gb SAS, 3.34 TB storage pool, one storage space
Network	
Server Connections	All physical and virtual servers utilized 1 GbE
Load Balancer	F5 Networks BIG-IP 1600 Series Local Traffic Manager Round-Robin I/O Scheduling





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