



# Best practices for a Microsoft Hyper-V Dynamic Data Center in an HP BladeSystem environment

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## Executive summary

This document provides a general reference for a proof of concept for Microsoft® Hyper-V in a dynamic data center scenario utilizing HP BladeSystem c-Class technology. Contained in this reference is an overview of what components HP recommends for implementing a Microsoft Hyper-V dynamic data center scenario on its BladeSystem c-Class technology, including where components should be installed within the BladeSystem enclosure and when such information can be helpful to the construction of the solution. This document should be used as a general reference only for HP BladeSystem and Microsoft Hyper-V in a dynamic data center scenario.

**Target audience:** The intended audience for this document is general IT or business management, solutions architects and/or technical consultants requiring an understanding of and familiarization with HP technologies and Microsoft Windows® Server 2008 Hyper-V software. This document does not propose to teach the reader about Windows Server 2008 Hyper-V or the deployment of applications on top of Windows Server 2008 Hyper-V.

**Advisory:** The HP hardware technology and software products described in this document are current as of September 2008. HP regularly updates existing hardware technology and software products and periodically develops new hardware technology and software products. The reader of this document is advised to check the official [HP website](#) for the most current information on HP hardware technology and software products.

## Overview

Recent advances in server hardware such as multi-core processors, fast memory, and storage subsystems have brought a strong interest in server virtualization from businesses and new software for managing virtual server hardware from independent software vendors (ISVs).

Interest in virtualization technology from most businesses is very common and businesses are often looking for cost-effective ways to add newer and richer applications to fuel and grow their businesses. Server virtualization addresses many issues associated with managing IT resources and provides the platforms required for these richer applications.

Recently, Microsoft introduced Microsoft Windows Server 2008, along with a key feature – Hyper-V. Windows Server 2008 Hyper-V, the next-generation hypervisor-based server virtualization technology, allows you to make the best use of your server hardware investments by consolidating multiple server roles as separate virtual machines (VMs) running on a single physical machine. With Hyper-V, you can also efficiently run multiple different operating systems – Windows, Linux, and others – in parallel, on a single server, and fully leverage the power of x64 computing.

With the introduction of Hyper-V, Microsoft has introduced four scenarios, which will be the most common forms of implementing Hyper-V. These four scenarios are Server Consolidation, Business Continuity and Disaster Recovery, Testing and Development, and Dynamic Data Center. This document is intended to discuss the dynamic data center scenario in an HP BladeSystem environment.

Typically a dynamic data center will have components providing management of the system, functionality of the system, hardware platforms (server and storage), and network interconnects.

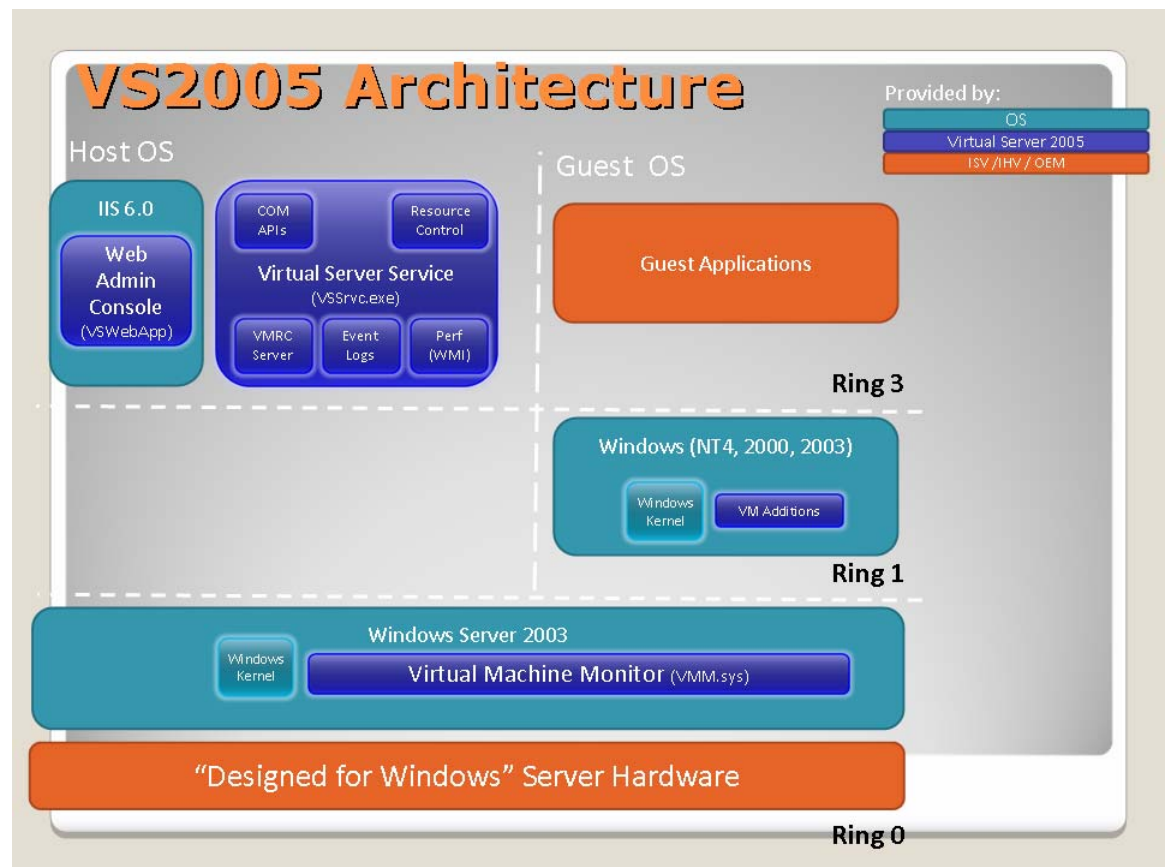
This document provides a view of the components from Microsoft, HP, and F5 Networks (F5) used to construct such a system as well as guidelines for implementing a dynamic data center.

# Hypervisor-based virtualization

Much has been written about virtualization and types of virtualization. First, it is helpful to discuss virtualization privileges to set the context for this document.

Software, including virtualization software, runs in one of four rings. These rings are also referred to as privilege levels; these rings are labeled ring 0-3. Server operating systems such as Microsoft Windows Server run in ring 0. Ring 0 provides the greatest level of access to processor and server resources. Applications on the server usually run in ring 3. The following diagrams explain the architectural differences in Microsoft's first virtual machine manager, Microsoft Virtual Server 2005, and Microsoft's most recent product, Hyper-V.

**Figure 1.** Microsoft Virtual Server 2005 Architectural Diagram



## Microsoft Virtual Server 2005

At the most basic level, a virtual machine manager is responsible for partitioning the physical server hardware and providing a guest operating system and its applications with access to the server hardware. Microsoft Virtual Server 2005 accomplishes this by emulating server hardware and providing resources to the guest operating systems. Keeping in mind that ring 0 provides the greatest access to hardware resources and ring 3 the least, this section looks at how Virtual Server 2005 emulates a virtual server environment.

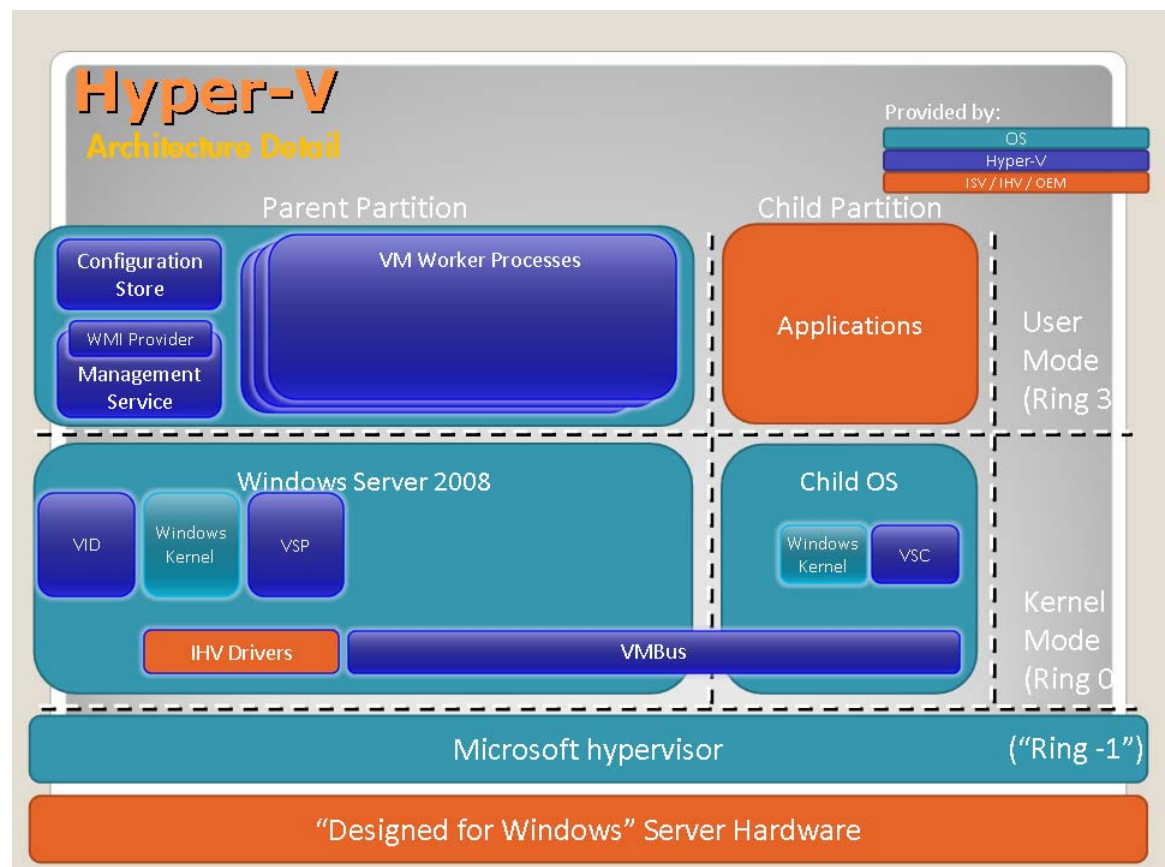
Virtual Server 2005 is sometimes referred to as host-based virtualization or full virtualization. Full virtualization means that every aspect of the hardware is emulated.

The virtual machine monitor in Virtual Server 2005 runs at a higher CPU privilege level (ring 0) in order to maintain isolation, control and trap system calls made by virtual machines. Virtual Server 2005 runs the virtual machines' operating systems in ring 1 emulating ring 0 and in a sense making the operating system on the virtual machine think it is running in ring 0.

The virtual server service, which runs in ring 3, is a single process used to instantiate all virtual machines, instantiate all virtual devices for all virtual machines, handle event logging, and act as a scripting interface. The obvious issue with this approach is that a single fault in the virtual server service can result in issues with all the virtual machines running on the server.

Figure 2 illustrates the architectural differences and improvements made in Hyper-V.

**Figure 2.** Microsoft Hyper-V Architectural Diagram



## Microsoft Hyper-V

Virtualization in a Hyper-V environment is different from the Microsoft Virtual Server approach. As shown in Figure 2, in the Microsoft Hyper-V model, the hypervisor runs below ring 0 in ring -1, directly on the physical server hardware.

Hyper-V manages virtual machines by partitioning the hardware, thus creating virtual partitions. There is one parent partition, which runs Microsoft Windows Server 2008, and there can be several child partitions. An independent operating system runs on each of the child partitions. For example, child partition one might be running Windows Server 2003, while child partition two might be running another operating system such as Linux. All of these partitions run in ring 0 with the highest level of privileges to hardware access.

In addition, the parent partition contains independent hardware vendor (IHV) drivers, such as provided by HP. The virtual infrastructure driver (VID) is used for memory virtualization and instruction completion for child partitions. The virtual service provider (VSP) handles input/output (I/O) requests. The VMBus allows for communication between the VSP and virtual service client (VSC) on the parent and child partitions.

The IHV drivers, in the parent partition, manage interactions with hardware devices. These drivers are a major difference between Hyper-V and Microsoft Virtual Server. With the Microsoft Virtual Server model, the hardware is emulated for each of the virtual machines. With Hyper-V the drivers are provided by HP and install within the parent partition. The virtual machines access the native drivers through the high speed VMBus through special “enlightenments” within the guest operating system in the virtual machine. These enlightenments provide high performance access to the core device drivers in the parent partition without the overhead of hardware emulation.

The child partitions contain an operating system kernel, a virtual service client (VSC), and the VMBus. All child partitions communicate with the parent partition through the VMBus. Communications between child and parent partitions are required for management purposes.

With an understanding of how Hyper-V partitions work, it is clear to see the benefits this architecture brings to a data center. A significant amount of systems integration is required to deploy a dynamic data center configuration of Hyper-V. However, once deployed, it provides a self-healing, self-managing environment for your applications. For the proof of concept described in this paper, tools from Microsoft, F5 and HP were used. The next sections take a look at the tools that were used.

## Microsoft tools

As mentioned earlier, many software tools are required to deploy a fully functional dynamic data center configuration for Hyper-V. These tools include Microsoft Windows Server 2008, Hyper-V, System Center Operations Manager, System Center Virtual Machine Manager, and PowerShell for creating and managing automation scripts.

### Microsoft Windows Server 2008

Windows Server 2008 is the latest server operating system from Microsoft ([www.microsoft.com/windowsserver2008](http://www.microsoft.com/windowsserver2008)). Microsoft Windows Server 2008 builds on previous versions of Windows and provides many new features such as virtualization. In addition, Server Core is new in Windows Server 2008. Server Core is an installation option of Windows Server 2008 that installs the necessary components and subsystems required for a Windows Server, but does not install a graphical user interface.

### Hyper-V

Windows Server 2008 Hyper-V, as mentioned earlier, is the next-generation hypervisor-based server virtualization technology from Microsoft. This technology allows businesses to make the best use of server hardware investments by consolidating multiple server roles as separate virtual machines running on a single physical machine. Implementing Hyper-V also allows businesses to efficiently run multiple operating systems – Windows, Linux, and others – in parallel on a single server.

Microsoft provides multiple scenarios for implementing Hyper-V. These scenarios are

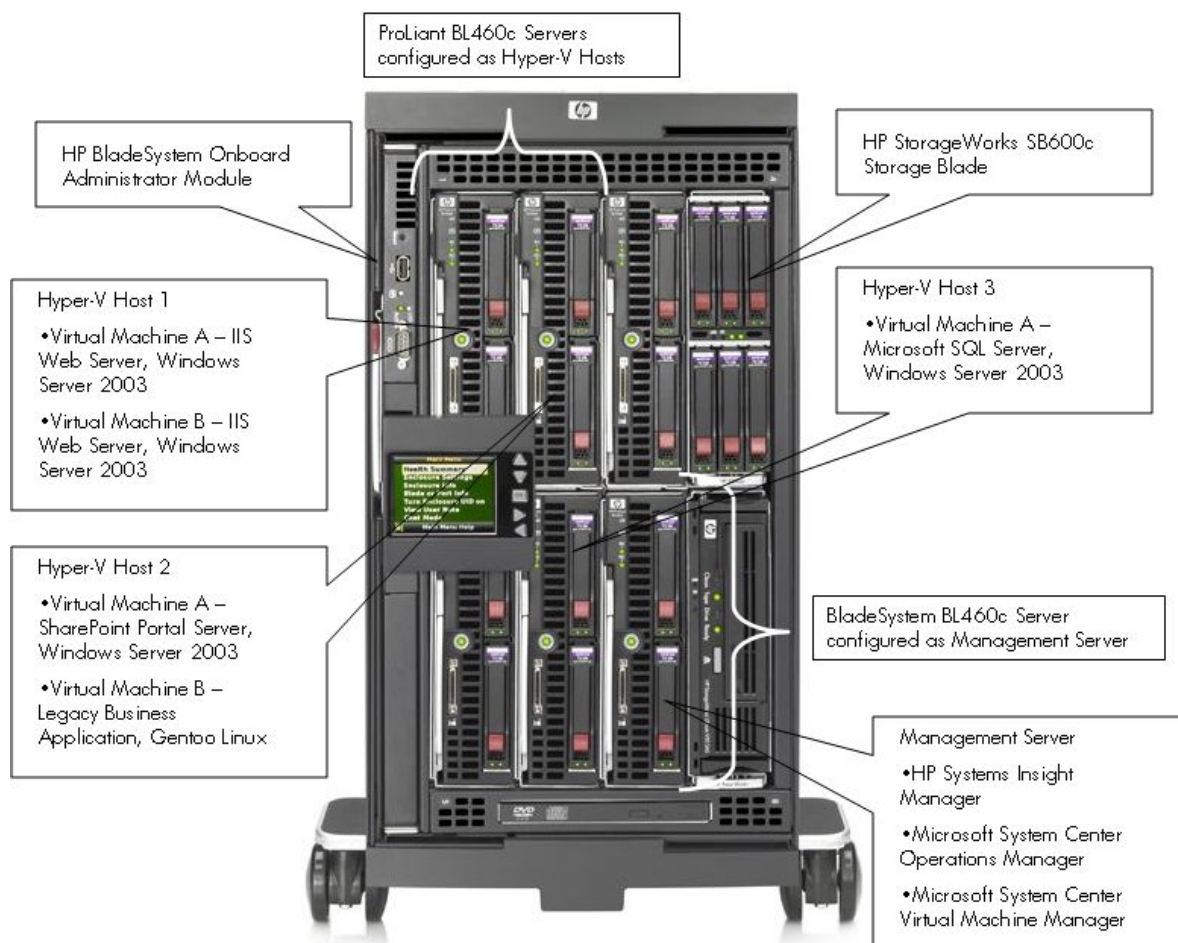
- Server Consolidation
- Business Continuity and Disaster Recovery
- Testing and Development
- Dynamic Data Center

For the purpose of this paper, HP focused on the dynamic data center scenario. For complete information on the other scenarios, please visit [www.microsoft.com/hyper-v](http://www.microsoft.com/hyper-v).

Dynamic data center is described as a self-managed, self-healing platform that provides a robust environment for business critical applications. Hyper-V, together with your existing system management solutions, such as Microsoft System Center, HP Systems Insight Manager, and HP ProLiant management components, can help make the dynamic data center vision a reality. Together these components integrate to provide a dynamic environment based on virtualization technology that allows for a quick response to system problems and helps manage system resources when demands increase.

For example, with a dynamic data center based on Hyper-V virtualization and various HP and Microsoft management tools, one can create an application farm consisting of many virtual machines, each running its own independent operating system and providing users with unique applications. Figure 3 shows an HP BladeSystem c3000 enclosure populated with HP ProLiant BL460c server blades, HP StorageWorks SB920c tape blade, and an HP StorageWorks All-in-One SB600c storage blade. The diagram shows the ProLiant BL460c servers hosting Hyper-V virtual machines with applications and management components.

**Figure 3.** BladeSystem c3000 Enclosure with Hyper-V hosts and Management Server





## Microsoft System Center Operations Manager

Microsoft System Center Operations Manager is a software solution to meet the need for end-to-end service monitoring in the enterprise IT environment. System Center Operations Manager provides an easy-to-use monitoring environment that monitors servers, applications, and clients to provide a comprehensive view of the health of an organization's IT environment. This view of service health is key to a rapid, agile response to events that may impact the normal running of business and ultimately cost an enterprise money.

Microsoft System Center Operations Manager integrates application, client, server, and synthetic transaction monitoring into a single management environment. The system manages and monitors business critical services such as Microsoft Exchange Server, Microsoft Office SharePoint products and technologies, and Microsoft Active Directory domain services. In addition it also manages a wide range of line-of-business applications that use Microsoft Windows Server, Microsoft SQL Server, Microsoft .NET Framework, and Internet Information Services (IIS), as technology building blocks.

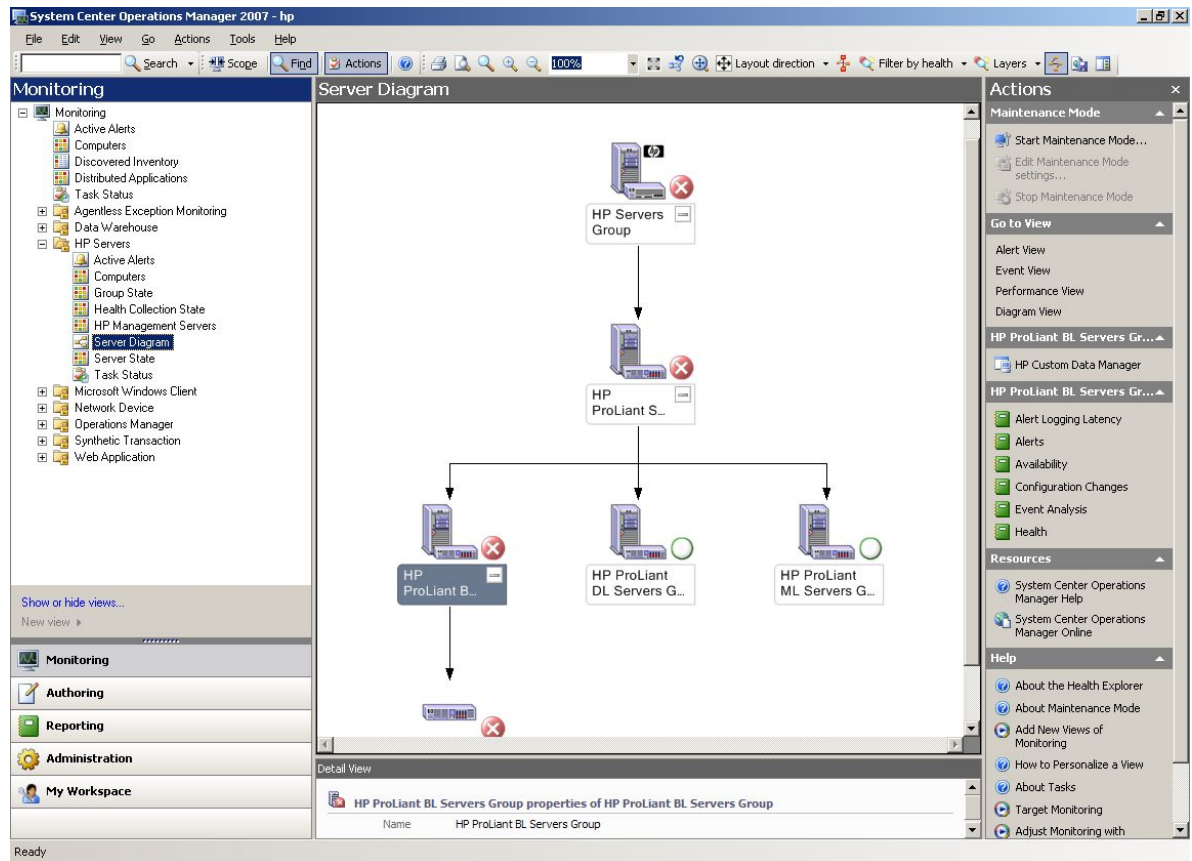
A key feature of Microsoft System Center Operations Manager is its extensibility. Microsoft provides management packs for more than 60 Microsoft products. Through the use of management packs, management of these products can be done in the Microsoft System Center Operations Manager environment. In addition to the Microsoft-supplied management packs, Microsoft has a partnership in which ISVs can build and provide management packs for their products. HP participates in the partnership and provides the *HP ProLiant Server and BladeSystem Management Packs for Microsoft System Center Operations Manager*. Download the management packs at <http://h18013.www1.hp.com/products/servers/management/mom2007/>.

The HP ProLiant Server and BladeSystem Management Packs for Microsoft System Center Operations Manager allow administrators to obtain greater visibility of HP ProLiant and BladeSystem servers in a System Center Operations Manager environment. The key features include:

- View HP ProLiant server and BladeSystem server events as alerts and state in the native Operations Manager format
- Ability to separate discover and state monitoring into multiple rules
- Support for Operations Manager diagram view including graphical characterization
- Illustrates relationships of HP ProLiant servers and subsystems
- Rolls up HP server state to the highest level
- Automatic discovery and grouping of HP servers
- Definition of HP servers and blades utilizing Operations Manager object model, down to a server subsystem
- Store user-defined text per HP server or blade in the Operations Manager database
- Custom data available in particular Operations Manager views
- Ability to export/import data with Microsoft Office Excel to HP's Custom Data Manager

Figure 4 shows the Microsoft System Center Operations Manager console running the HP ProLiant Server and BladeSystem Management Packs. The console shows the server diagram view of the HP products; in this particular diagram, there is an error present in one of the BladeSystem servers, which can be isolated by drilling down on the diagram until the error is discovered.

**Figure 4.** Microsoft System Center Operations Manager with HP ProLiant Server and BladeSystem Management Packs



## Microsoft System Center Virtual Machine Manager

Microsoft System Center Virtual Machine Manager (SCVMM) is a straightforward and cost-effective solution for IT professionals responsible for managing virtual infrastructure, providing unified management of physical and virtual machines, consolidation of underutilized physical servers, and rapid provisioning of new virtual machines by leveraging the expertise and investments in Microsoft Windows Server technology.

Microsoft System Center Virtual Machine Manager 2008 is the latest product from Microsoft and supports management of Hyper-V virtual machines. This product is designed to utilize the foundational features of Windows Server 2008 and Hyper-V.

Microsoft System Center Virtual Machine Manager 2008 supports management of Hyper-V hosts and can remotely control a Hyper-V host directly from its console. In addition, the system tightly integrates with Windows Server 2008 to allow for fault-tolerant and cluster-aware virtual machines to be deployed.

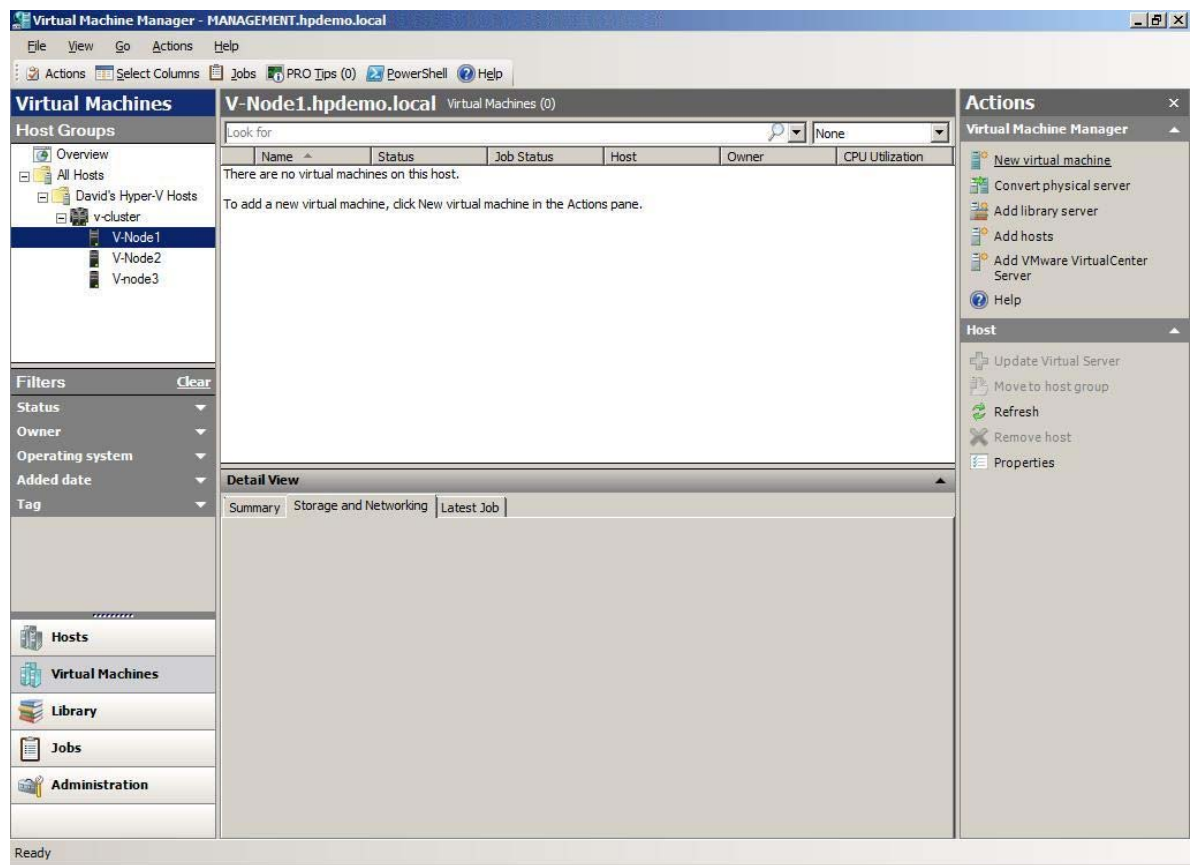
The product also allows for management of non Hyper-V environments such as virtual machines based on Microsoft Virtual Server 2005 or VMware ESX servers.

The environment for Microsoft System Center Virtual Machine Manager 2008 makes extensive use of Microsoft PowerShell scripts for custom management or automation. It is this automation that allows this product to be customized when implementing a dynamic data center.



Figure 5 shows the Microsoft System Center Virtual Machine Manager 2008 console managing a clustered Hyper-V host with three Hyper-V guests.

**Figure 5.** Microsoft System Center Virtual Machine Manager

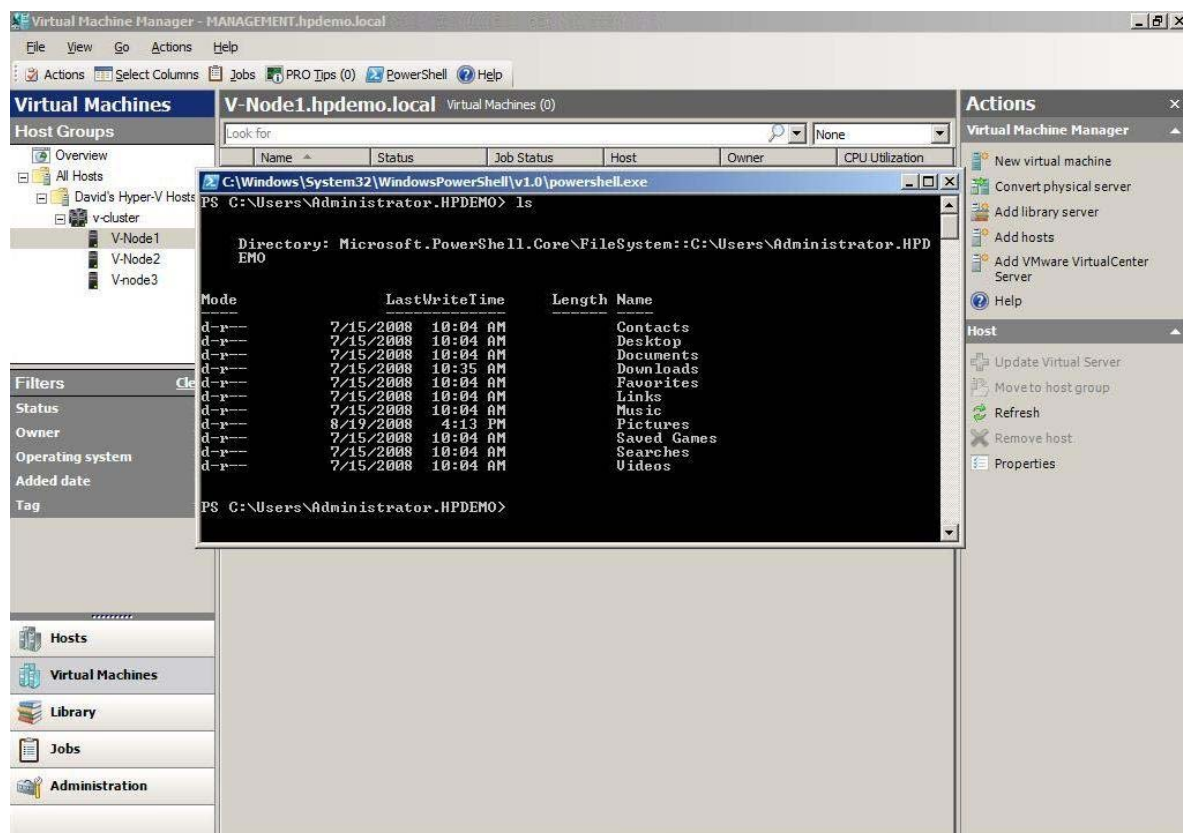


## Microsoft PowerShell

Windows PowerShell is a new command line shell and task-based scripting technology that provides IT administrators with comprehensive control and automation of system administration tasks, thereby increasing administrator productivity. Windows PowerShell includes numerous system administration utilities, consistent syntax and naming conventions, and improved navigation of common management data such as the registry, certificate store, or Windows Management Instrumentation (WMI). Windows PowerShell also includes an intuitive scripting language specifically designed for IT administration.

Windows PowerShell is available when Windows Server 2008 is installed, or it can be downloaded from [www.microsoft.com/](http://www.microsoft.com/). Windows PowerShell is easy to use and very powerful; it is also integrated with System Center Operations Manager and System Center Virtual Machine Manager. It is through this integration that PowerShell becomes a key control mechanism for managing a dynamic data center. For example, custom scripts can be built that automate tasks like stopping or starting virtual machines, deploying new virtual machines, managing network devices such as switches and other devices. Several PowerShell scripts for managing and controlling an environment are available for download from Microsoft; for further details, see <http://www.microsoft.com/windowsserver2003/technologies/management/powershell/default.msp>.

**Figure 6.** Microsoft PowerShell Launched From Virtual Machine Manager Console



As mentioned earlier, Microsoft PowerShell is integrated with System Center Virtual Machine Manager and is a key component in managing a dynamic data center. Figure 6 shows PowerShell as it is launched from the System Center Virtual Machine Manager console.

## HP tools

A dynamic data center is an approach to providing a self-monitoring and self-healing platform for an application through integration of various components. Building and managing an infrastructure for a dynamic data center requires having components beyond the management software from Microsoft. HP products are uniquely qualified to support a dynamic data center. HP has long been a leader in developing advanced computing platforms, for example the HP Adaptive Infrastructure (<http://h71028.www7.hp.com/enterprise/cache/483791-0-0-0-121.html>). For this dynamic data center proof of concept, the components used were from Microsoft, HP and F5. The components from Microsoft have been discussed; this section looks at the HP components.

### HP Systems Insight Manager

HP Unified Infrastructure Management allows for systems management unified around a single tool. This approach consolidates all tools needed to manage HP products into a single environment. This tool is HP Systems Insight Manager (HP SIM). HP SIM comes with every ProLiant server or is available for download at <http://www.hp.com/go/hpsim>.

HP SIM comes with remote support for managing ProLiant servers anywhere, control for Windows servers, and can be extended through the use of ProLiant Essentials software. For a complete list of ProLiant and Storage Essentials plug-ins, please see:

<http://h18013.www1.hp.com/products/servers/management/hpsim/plugin-apps.html>.

At the most basic level of HP SIM, there is a feature called the System Management Homepage. This page is a collection of management data for the server's elements such as processor, NIC, storage, and other components. For the purpose of this proof of concept, the System Management Homepage was used to manage the physical elements of the servers hosting the Hyper-V hosts.

**Figure 7.** System Management Homepage for Hyper-V Host

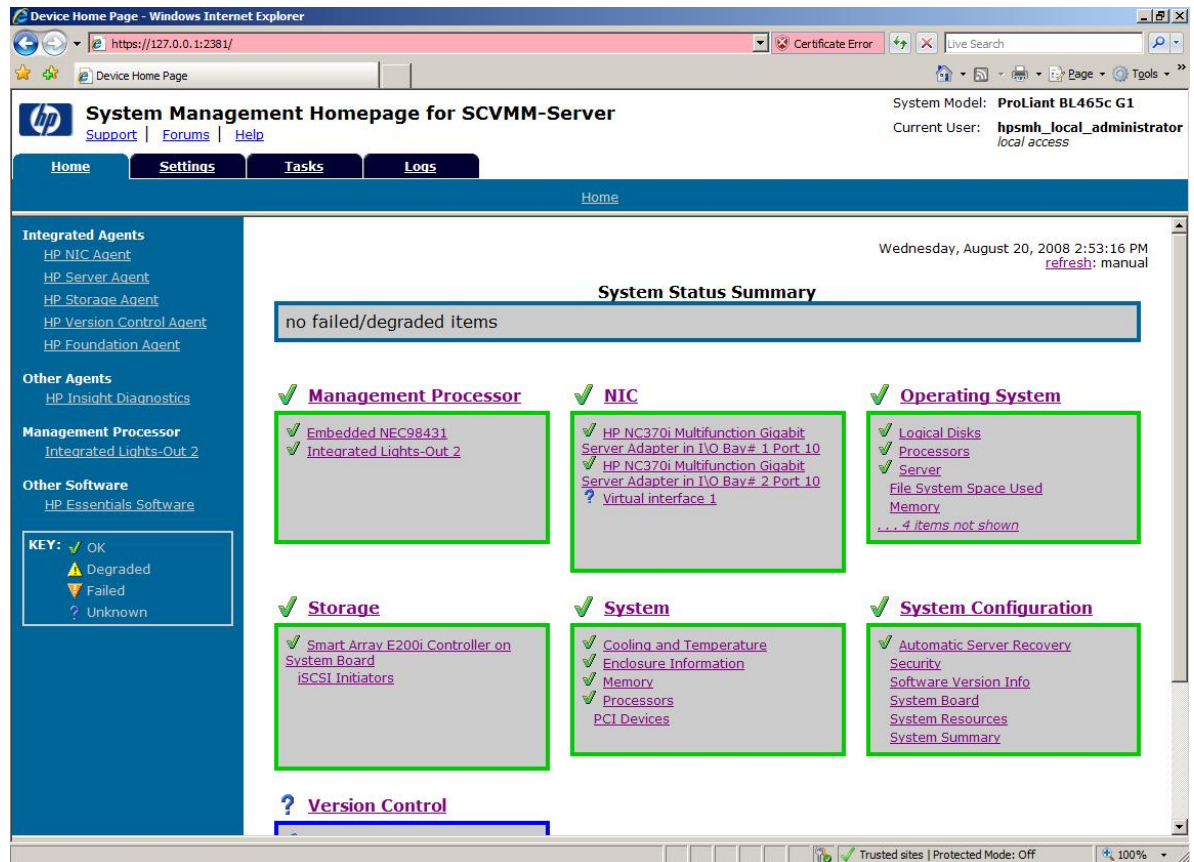


Figure 7 shows the System Management Homepage for a ProLiant BL465c server configured as a Hyper-V host. The management page allows administrators to look at the health of the various subsystems in the server. The interface provides a very easy-to-use tool for drilling down on degraded subsystems to identify issues and provide recommended steps for rectifying the issues.

**Figure 8.** System management Homepage Showing CPU Utilization on Hyper-V Host

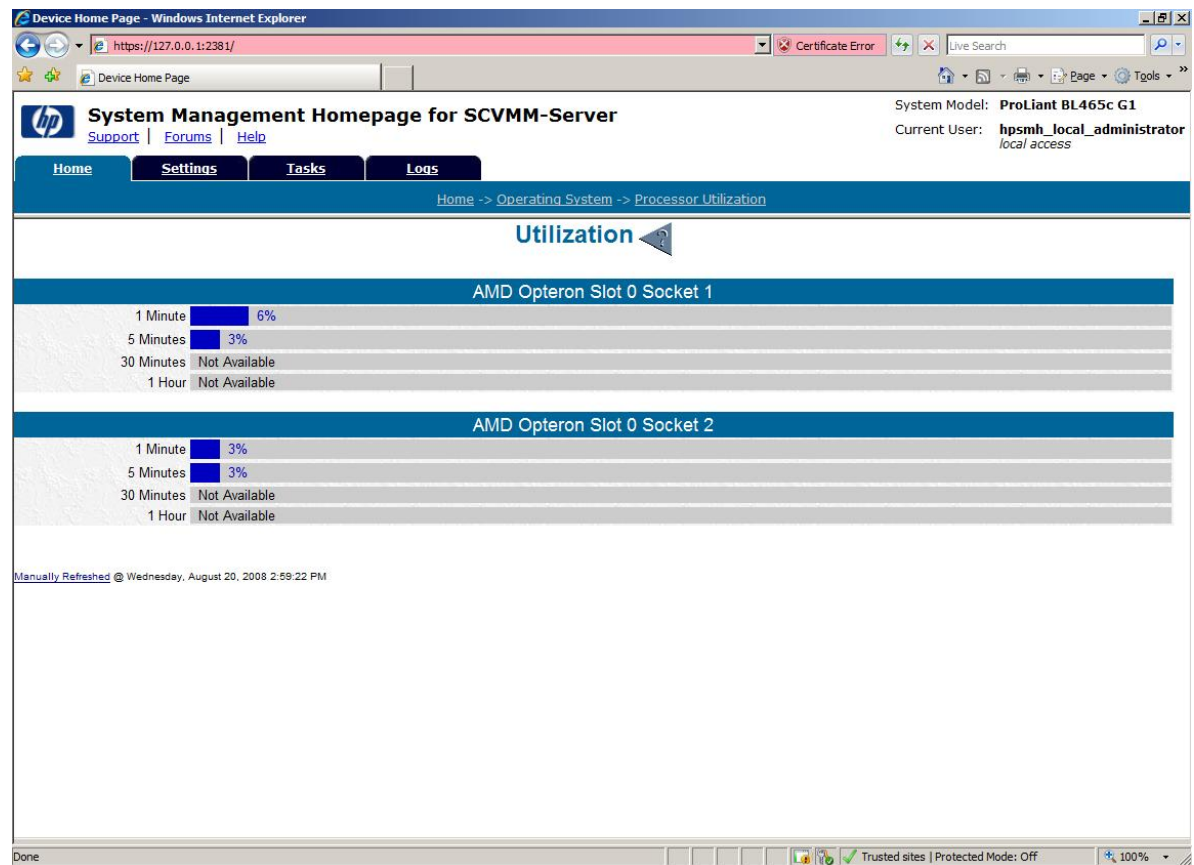


Figure 8 shows an historical view of processor utilization on a ProLiant BL465c server. This type of data provides useful information in a dynamic data center for identifying possible candidates for new Hyper-V hosts.

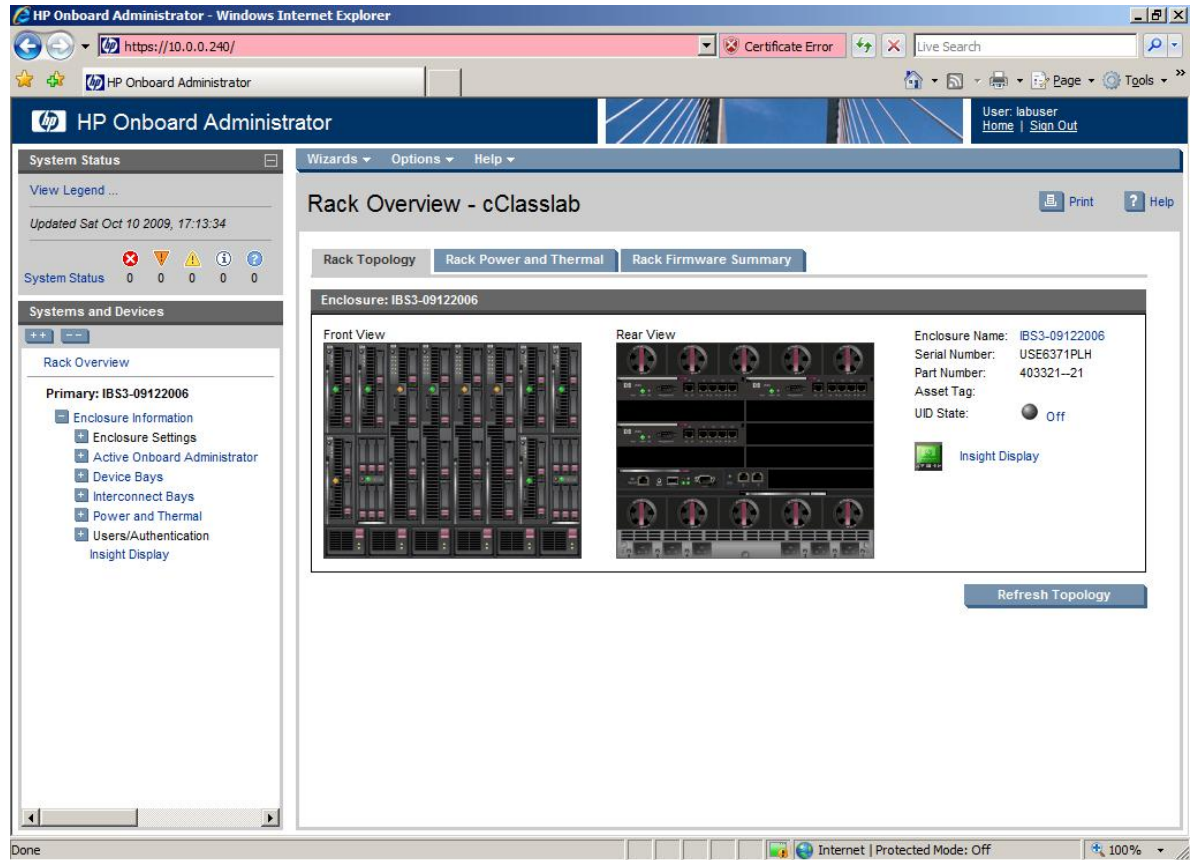
## HP Onboard Administrator

The HP Onboard Administrator for HP BladeSystem enclosures is the brains of the HP ProLiant c-Class infrastructure. Together with the enclosure's HP Insight Display, the Onboard Administrator has been designed for both local and remote administration of HP BladeSystem c-Class technologies. This module and its firmware provide:

- Wizards for simple, fast set up and configuration
- Highly available and secure access to the HP BladeSystem infrastructure
- Security roles for server, network, and storage administrators
- Automated power and cooling of the HP BladeSystem infrastructure
- Agent-less device health and status
- Thermal Logic power and cooling information and control

Each c-Class enclosure is shipped with an Onboard Administrator module/firmware. If desired, a second redundant Onboard Administrator module for each enclosure may be ordered. When two Onboard Administrator modules are present in a c-Class enclosure, they work in an active-standby mode, assuring full redundancy of the enclosure's integrated management.

**Figure 9.** HP Onboard Administrator Rack Topology View



Remote management is of very high importance when designing a system for a dynamic data center. With the correct set of remote management tools, an IT administrator's job is greatly simplified. The Onboard Administrator is one of several HP tools that provide this remote functionality, making HP BladeSystem best-in-class for remote manageability. The Onboard Administrator provides enclosure management for the rack topology, rack power and thermal settings, and rack firmware through a remote HyperText Transfer Protocol Secure (HTTPS) connection. Figure 9 shows the rack topology view of an HP BladeSystem c7000 c-Class enclosure.



Figure 10. HP Onboard Administrator Rack Power and Thermal View

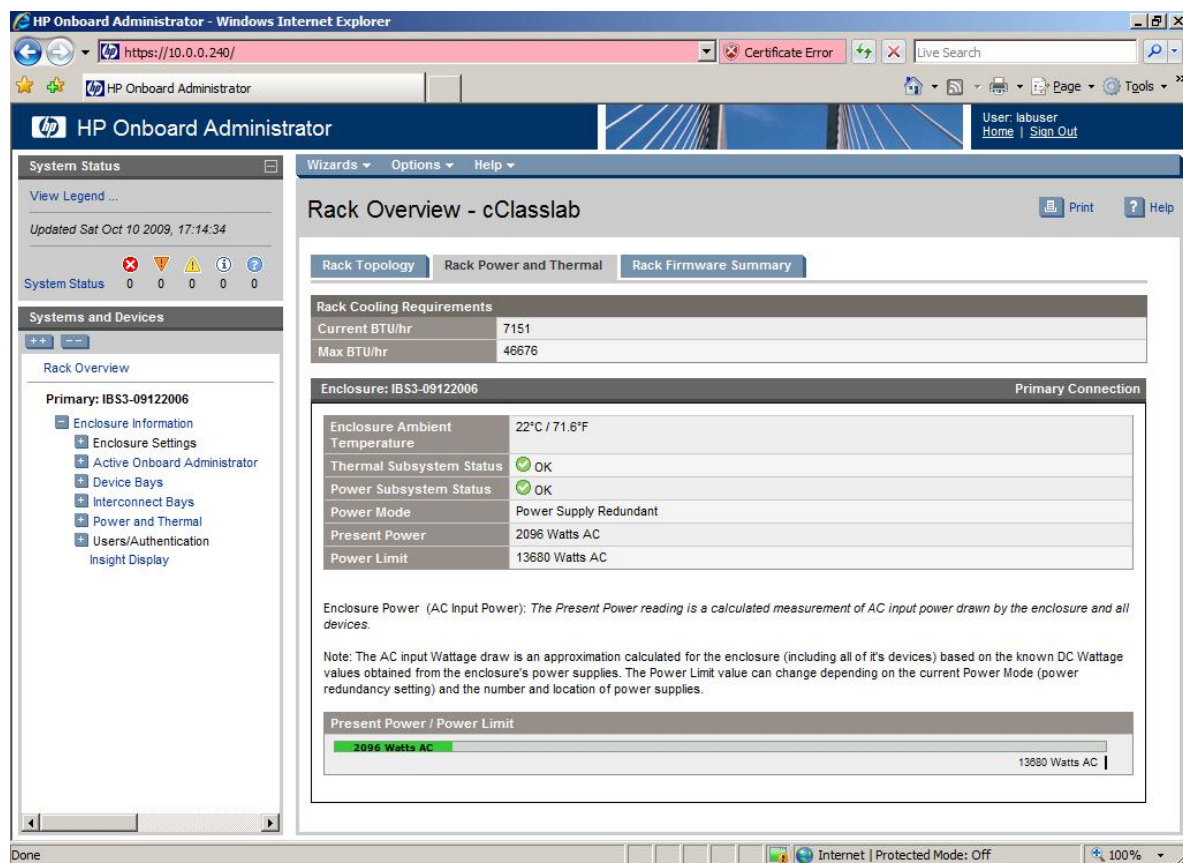


Figure 10 shows the rack power and thermal view of the managed enclosure. This view provides valuable information for calculating the power usage in the data center.

## HP Integrated Lights-Out 2 (iLO 2)

HP Integrated Lights-Out 2 (iLO 2), Standard Blade Edition, enables essential remote management capabilities bundled as standard features on most ProLiant BL c-Class blade servers. With iLO 2 Standard Blade Edition, you can take full advantage of the HP BladeSystem headless infrastructure to perform a wide variety of system administration tasks remotely.

iLO 2 Standard Blade Edition provides all of the remote control capabilities typically offered as standard features on ProLiant servers plus the new high-performance, Virtual KVM remote console and browser-based virtual media that are essential to administering HP BladeSystem servers. In addition, anytime access to system management information, such as hardware health, event logs and configuration, is available to troubleshoot and maintain blades.

iLO 2 Standard Blade Edition is based on HP's new fourth generation Lights-Out management processor and firmware integrated on c-Class servers. For more advanced Lights-out management capabilities, the iLO 2 Standard Blade Edition may be upgraded with the optionally licensed product, ProLiant Essentials iLO Select Pack. iLO 2 Select enables more advanced security, virtual media and power management capabilities.



With HP Integrated Lights-Out 2 firmware v1.60, iLO 2 Standard provides the following remote control capabilities.

- Remotely control system power and UID from the HP Systems Insight Manager menu and management tools that are compliant with the Distributed Management Task Force's new industry standard, WS Management.
- International keyboard support from all iLO 2 remote console features
- Overall better performance
- Protect server data with Use FIPS 197-compliant AES encryption of browser, SSH, XML interfaces.
- Enhanced user audit support with increased logging options for failed login attempts and new logging of client machine names

As shown in Figure 11, the iLO 2 console is web-based and accessed through an HTTPS connection. The console provides status summary information as well as remote console, virtual media, power management, and administration capabilities.

**Figure 11.** HP iLO 2 Summary View

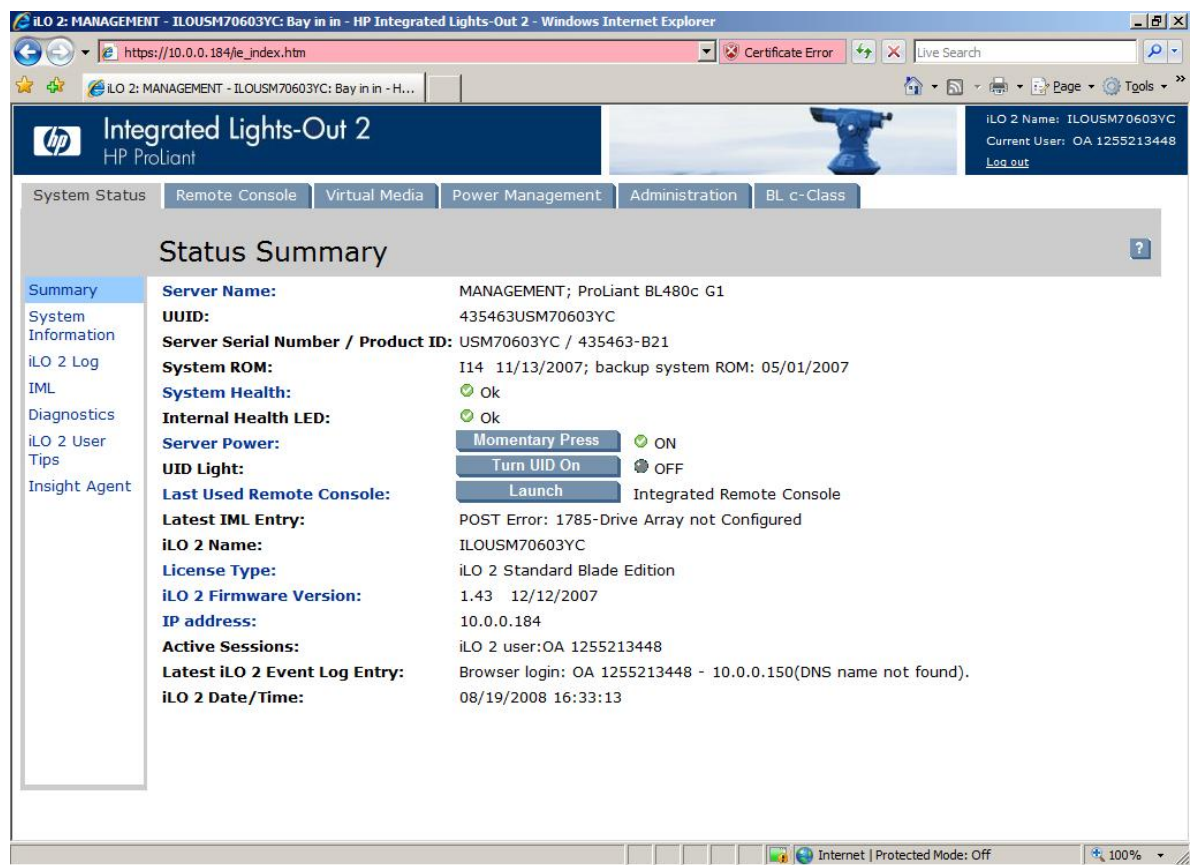


Figure 11 shows a summary view of the system status page. This view provides a general overview of the ProLiant BL model server in the enclosure. In addition to the summary, one can view the system information, iLO 2 log, diagnostics and other management data from this page.

Figure 12. HP iLO 2 Remote Console View

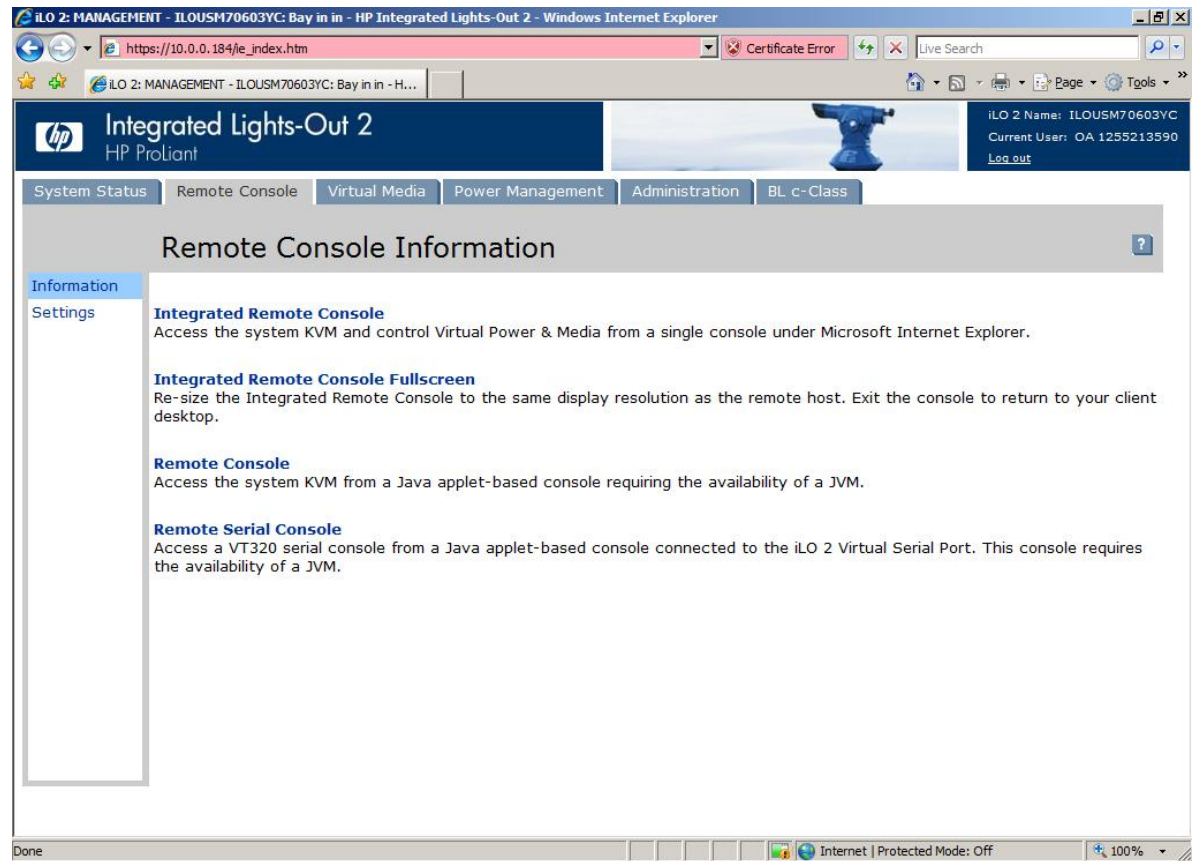


Figure 12 shows the remote console page for the iLO 2 device on the managed server. Through this page, an administrator can reach the server's console through one of the remote console options. Once connected to the server with the remote console, the administrator can manage the server as if logged on locally.

Figure 13. HP iLO 2 Power Management View

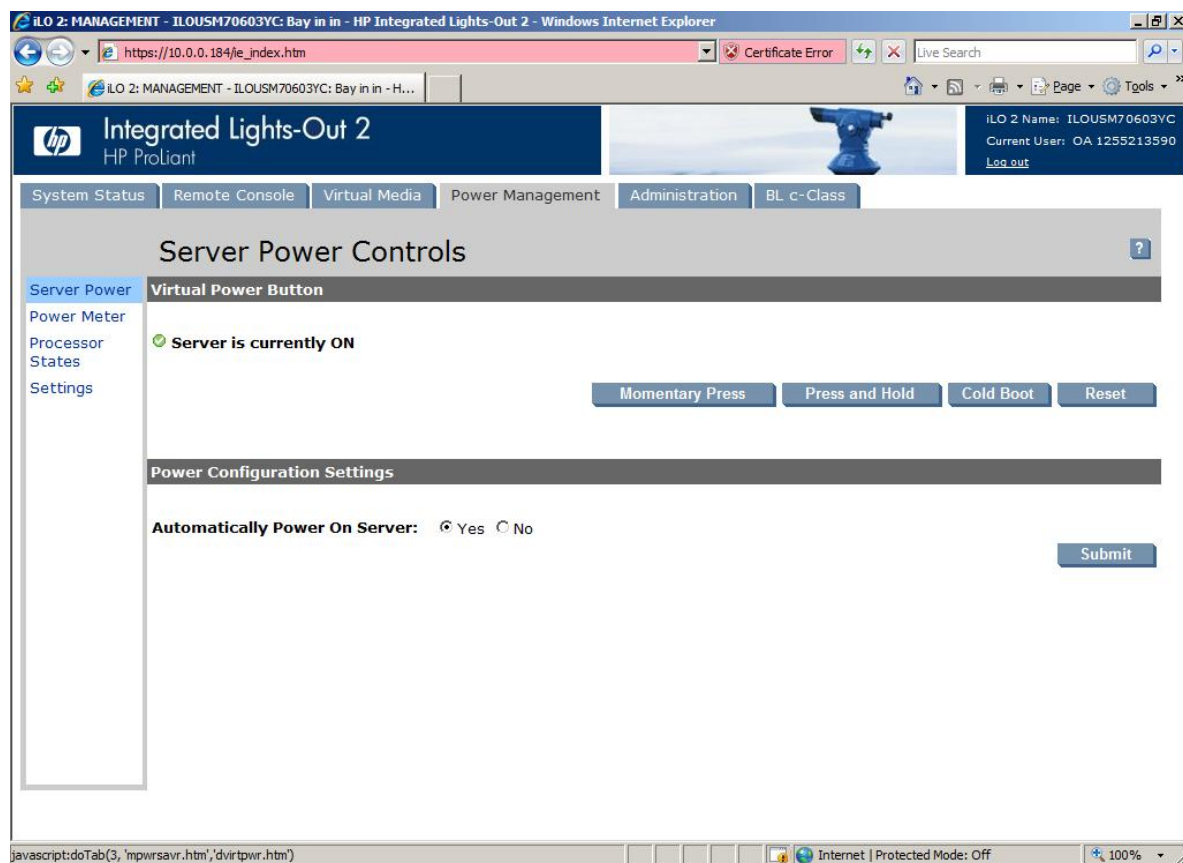


Figure 13 shows the server power controls view of the power management tab. Through this console, an administrator can manage the power switch on the server just as if the server were physically present. An administrator can cold boot the server, reset the server, or momentarily press or press-and-hold, which are options to remotely control the power switch.

In addition to these power control settings, an administrator can use the power meter view to see how much power the system is consuming.

When planning for a dynamic data center, all of the data provided by the HP management tools become very valuable for making decisions on which servers Hyper-V hosts can be configured. The HP servers and tools and the Microsoft tools have been discussed; the next section looks at the F5 tools available for managing the network in a dynamic data center.

## F5 tools

F5 Networks is an HP partner that is a global leader in application delivery networking; as such F5 has made significant development investments into building advanced technologies and tools that enable the network to provide significant value in a virtualized environment. One of the key benefits of a dynamic data center is that resource management becomes a fluid model with resources dynamically shifted around the data center, based upon need. However, until awareness is built into the infrastructure, the manual process of advertising to clients where those resources have moved still remains.

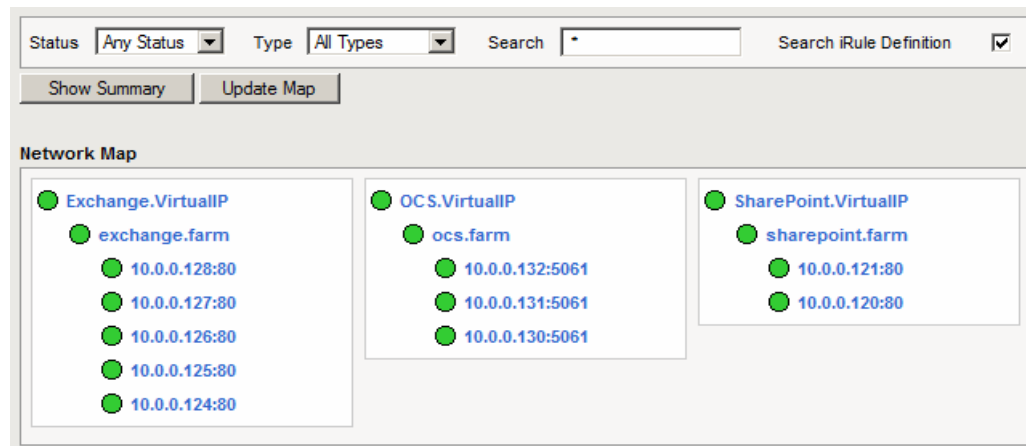
The F5 product line of intelligent network devices integrates with virtualization tools from Microsoft System Center as well as HP Systems Insight Manager to programmatically modify the network in order to make sure clients are always sent to the best performing resources in this dynamic virtual environment.

F5's integration with System Center Operations Manager and HP Systems Insight Manager allows for mutual benefit in a virtualized environment. Because the F5 devices are aware of the surrounding network conditions, this information, such as latency and congestion, can be reported to System Center Operations Manager for reporting and remediation purposes. Conversely, System Center Operations Manager is able to proactively instruct F5 devices via PowerShell to modify the network in response to certain conditions, such as server-based issues. It's a truly two-way street in which both provide immense value to each other.

## Example of F5 in a virtualized environment

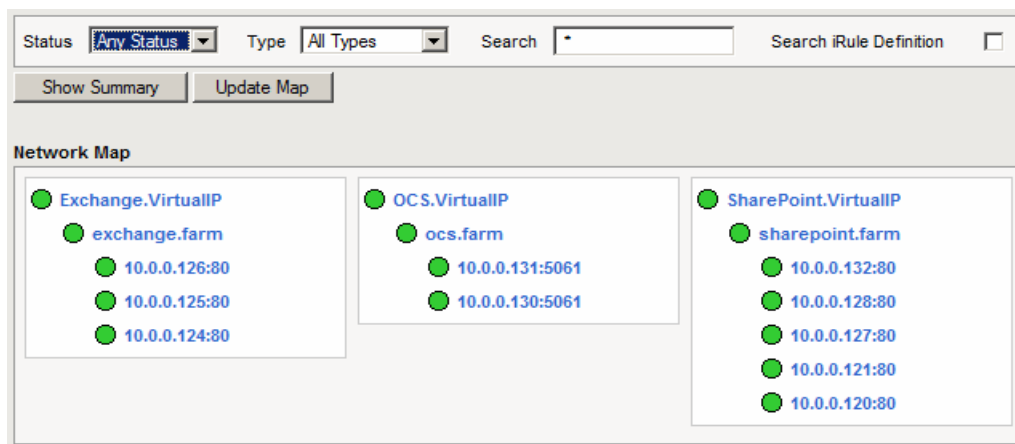
As an example of how the F5 BIG-IP Local Traffic Manager (LTM) operates in a virtualized environment, Figure 14 shows a single BIG-IP LTM device managing traffic to a Microsoft Exchange Server, Microsoft Office Communications Server (OCS), and a Microsoft Office SharePoint Server farm. The diagram shows the Exchange deployment initially has about the same amount of server resources dedicated to it as OCS and SharePoint combined.

**Figure 14.** BIG-IP Local Traffic Manager Device Managing Traffic to Various Hyper-V servers



As users start to move from using Exchange and OCS to SharePoint, it becomes necessary to dynamically provision more resources from the limited pool toward the SharePoint farm. System Center Operations Manager and System Center Virtual Machine Manager have the ability to determine if user load has changed, and whether servers need to be re-provisioned from Exchange and OCS deployments to SharePoint. In addition, with the integration of BIG-IP LTM and System Center Operations Manager, the BIG-IP configuration can be automatically modified to reflect the server-based changes made by System Center Operations Manager or System Center Virtual Machine Manager.

**Figure 15.** BIG-IP Local Traffic Manager after moving servers from Exchange and OCS Farms to a SharePoint Farm



## F5 technologies leveraged

F5 has developed several unique technologies to allow integration with management tools and provide tangible benefit within a dynamic data center. These include the iControl API, Health Modeling, and Intelligent Load Balancing.

### PowerShell enabled iControl API

iControl is an open API for F5 devices that enables applications to work with the underlying network based on software integration. Utilizing SOAP/XML to ensure open communications between dissimilar systems, iControl helps F5 customers, leading independent software vendors (ISVs), and solution providers realize new levels of automation and configuration management efficiency. Whether monitoring network-level traffic statistics, automating network configuration and management, or facilitating next generation service-oriented architectures, iControl gives organizations the power and flexibility to ensure that applications and the network work together for increased reliability, security, and performance.

The F5 iControl API and Simple Network Management Protocol (SNMP) engine enable F5 technology to report network and availability conditions to System Center Operations Manager with minimal configuration on either device. This information can then be consumed by System Center Operations Manager for reporting or remedial activities. F5 has developed a PowerShell script for configuring or managing the F5 device from the System Center Operations Manager environment. For complete details on this PowerShell script please see <http://devcentral.f5.com/Default.aspx?tabid=71>.

### Virtualization capable health monitoring model

In a virtualized environment in which applications are running on guest OSs stacked upon hosts, it is critical that resource monitoring takes place at every level of the stack. BIG-IP LTM has the technology to monitor each piece for availability and response times *from a client perspective* in order to make sure this information is available to BIG-IP LTM, System Center Operations Manager, System Center Virtual Machine Manager, or HP Systems Insight Manager.

### **Dynamic and intelligent load balancing**

When architecting a virtualized environment that relies on shared resources, performance (network, server, and application) becomes a critical piece that needs to be taken into account when determining where best to send the client requests. Availability should never be the only criterion; BIG-IP LTM has the ability to send users to the best performing resources based upon its own monitoring, as well as information gathered by System Center Operations Manager or HP Systems Insight Manager.

## **A Dynamic Data Center in an HP environment**

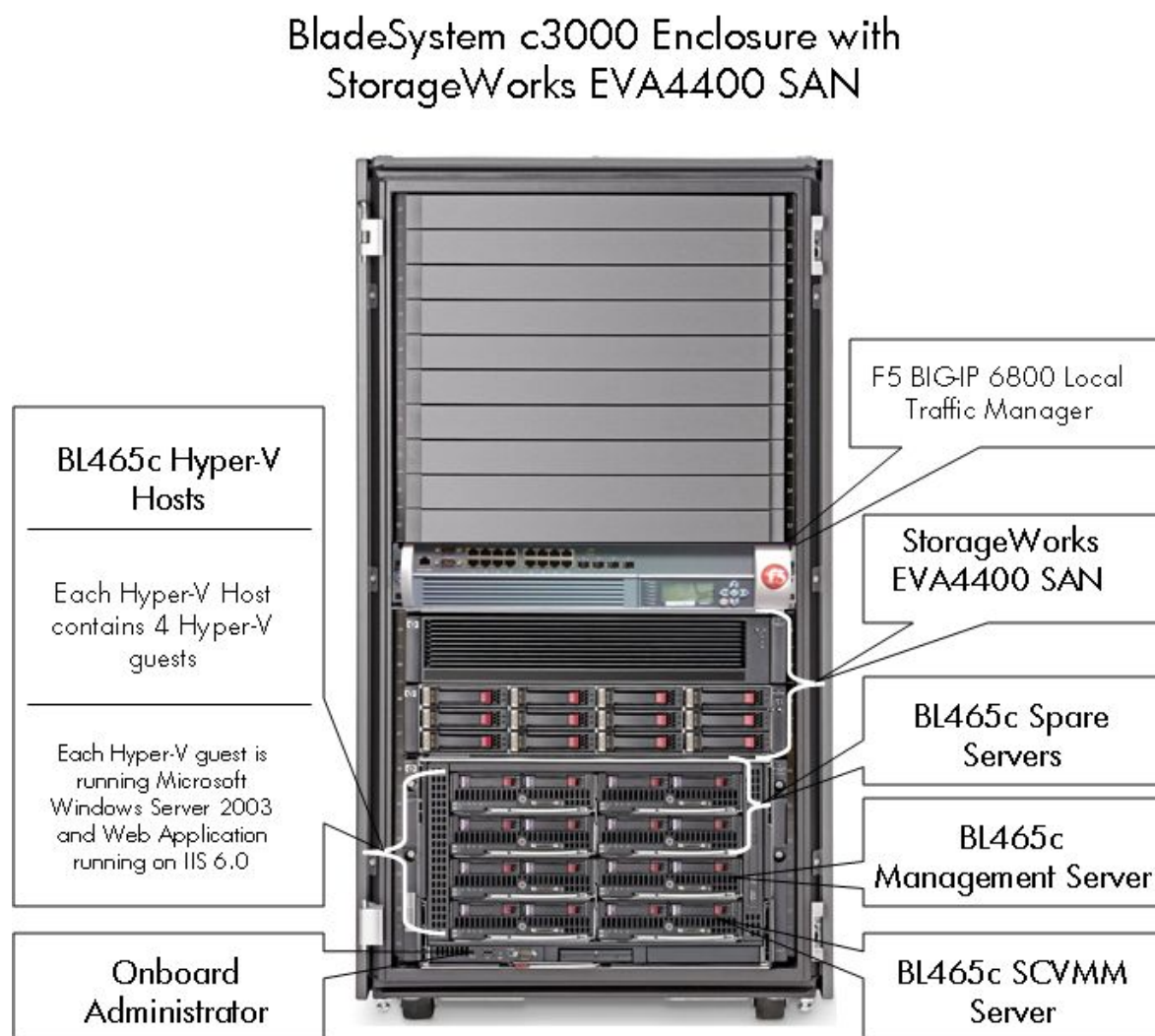
As mentioned earlier, HP has a long history of developing highly available and scalable platforms for applications. With this in mind, HP set out to show that HP platforms are well suited for deploying Microsoft's dynamic data center. The objectives were to use available management tools, leading network traffic management devices, and BladeSystem products. In addition, the goal was to use a web application running on Microsoft Internet Information Services (IIS) on each of the Hyper-V virtual machines and apply a client load to the application. Once the application exceeded a predetermined threshold, based on the virtual machine's CPU, a process that provisioned a new Hyper-V virtual server would be initiated.

In building this configuration, HP integrated disparate technologies and custom-developed PowerShell scripts for managing the process. As Hyper-V and its management technologies continue to mature, there will certainly be many approaches to achieving a dynamic data center.

At the foundation of this configuration, HP integrated management components, storage area network technology, F5 BIG-IP Local Traffic Manager, and HP BladeSystem servers. Figure 16 shows the various systems for the configuration. This section discusses the various components and the role each has in this system.



**Figure 16.** Hardware for Hyper-V Dynamic Data Center Scenario



### **F5 BIG-IP Local Traffic Manager**

The F5 device served as the entry point for the client requests to the web application. The F5 device contained a web farm with the TCP/IP addresses of each Hyper-V virtual machine. Using these addresses, the F5 device intelligently load balanced the requests from the clients to the available servers. In addition, F5 BIG-IP had iControl installed on it. Using the iControl API PowerShell script, the web farm it is responsible for can be programmatically controlled to add or remove hosts. This type of control enables the F5 BIG-IP device to be controlled in an automatic fashion, making it an ideal application delivery component for a dynamic data center.

### **BladeSystem servers**

The configuration contains eight ProLiant BL465c servers. These servers were selected for their quad-core CPU support and large amount of RAM. Each server was configured with dual AMD Opteron™ 2300 series CPUs and 32GB RAM. The servers were used for Hyper-V hosts, management servers, and spares.

### **Hyper-V hosts**

Four of the available servers were configured as Hyper-V hosts. Each Hyper-V host had Microsoft Windows Server 2008 Datacenter installed. Each of these hosts had the ability to run up to four Hyper-V child partitions. These partitions were configured as Windows Server 2003 web servers with IIS 6.0 activated and running the sample web application. Each of these systems attached to the storage area network where the files for the virtual machines were stored. The files were accessed by the server and moved to the target server where the VM ultimately ran and served up its application.

### **Storage area network**

The storage area network for this configuration was based on an HP StorageWorks 4400 Enterprise Virtual Array (EVA4400) storage device using iSCSI technology. The role of this device was to provide shared storage to the Hyper-V hosts for accessing stored virtual machine files. These files were the configuration files for the virtual servers. These files could be run on the Hyper-V host, thus providing a new virtual server into the infrastructure.

### **Management server**

One of the ProLiant BL465c servers was dedicated to being a management server. This management server was the central point for system and application management activities. This server ran HP Systems Insight Manager and Microsoft System Center Operations Manager. These systems provided insight to the health of the Hyper-V hosts and the web application.

In addition, this server ran a custom PowerShell script that showed the condition of each virtual machine. When the server reached a state defined to be too busy, another PowerShell script would start a new virtual machine on one of the hosts. Next, the F5 iControl PowerShell script was run to add the new server to the F5's farm of available servers.

## **Conclusion**

HP has a rich history in providing highly available and scalable computing architectures based on best-in-class technology. Now, together with Microsoft and F5, HP builds upon this history by adding Microsoft Hyper-V dynamic data center scenario as a viable platform for business-critical applications.

The configuration described in this document is the initial step in showing the integration of Microsoft, HP and F5 technologies that can provide a platform for Microsoft Hyper-V that is powerful enough to meet very high computing requirements. Recognizing that this is a first pass at building this technology, one can anticipate the changes and new technologies that will only strengthen this approach to computing. HP remains committed to developing and exploring new technologies, which will serve to mature this architecture.

## For more information

Microsoft Hyper-V Server Virtualization web page,  
<http://h71019.www7.hp.com/ActiveAnswers/cache/604725-0-0-0-121.html>

HP BladeSystem web page, [www.hp.com/go/bladeSystem](http://www.hp.com/go/bladeSystem)

HP ProLiant web page, [www.hp.com/go/proLiant](http://www.hp.com/go/proLiant)

HP Storage web page, [www.hp.com/go/storage](http://www.hp.com/go/storage)

Microsoft Hyper-V web page, [www.microsoft.com/hyper-v](http://www.microsoft.com/hyper-v)

Microsoft Windows Server 2008 web page, [www.microsoft.com/windowsserver2008](http://www.microsoft.com/windowsserver2008)

Microsoft System Center web page (Operations Manager and Virtual Machine Manager),  
[www.microsoft.com/systemcenter](http://www.microsoft.com/systemcenter)

Microsoft PowerShell with F5's iControl API, <http://devcentral.f5.com/Default.aspx?tabid=71>

F5 Virtualization web page, <http://www.f5.com/solutions/virtualization/>

F5 solutions for Microsoft web page, <http://www.f5.com/microsoft>

F5 DevCentral, <http://devcentral.f5.com>

To help us improve our documents, please provide feedback at [www.hp.com/solutions/feedback](http://www.hp.com/solutions/feedback)

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