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VMWARE ESXi SYSTEMS MANAGEMENT ON DELL POWEREDGE SERVERS

VMware® ESXi offers a simplified platform for enterprise virtualization. By integrating ESXi with Dell™ PowerEdge™ servers and using tools such as Dell OpenManage™ Server Administrator to monitor, inventory, and configure these systems, IT organizations can create scalable, highly manageable virtualized environments.

Virtualization has become a key tool in enterprise IT environments, enabling flexible resource management and optimized hardware utilization while helping simplify IT operations. By enabling IT staff to dynamically reprovision resources as needed, it can also help avoid planned downtime, enhance testing and development, and support rapid disaster recovery.

VMware ESXi, part of the VMware vSphere™ product suite, offers a simplified, manageable virtualization platform on Dell PowerEdge servers. It is functionally equivalent to the traditional VMware ESX platform, but its lack of a service console offers the advantages of a significantly reduced footprint, including simplified preinstallation on embedded devices within a server. Administrators can manage ESXi servers through remote interfaces that enable secure, centralized systems administration. By understanding the architecture of this platform and how to use tools such as Dell OpenManage Server Administrator (OMSA) to monitor, inventory, and configure ESXi servers, administrators can create scalable and highly manageable virtualized infrastructures.¹

VMWARE ESXi ARCHITECTURE

Figure 1 shows the VMware ESXi architecture in Dell PowerEdge servers. This architecture consists of a

purpose-built kernel, called the VMkernel, and processes that run on top of it. The ESXi hypervisor abstracts the underlying hardware from the virtual machines (VMs) and controls the resource allocation for different applications. Key components include the following:

- **Direct Console User Interface (DCUI):** Provides a basic management interface (accessed through a local console) for functionality such as setting administrative passwords, configuring networking, and performing troubleshooting tasks such as viewing logs and restarting management agents
- **Virtual Machine Monitors (VMMs):** Provide the execution environment for VMs
- **Agents:** Enable remote manageability from VMware tools such as the VMware vSphere Client and VMware vCenter Server
- **Management infrastructure:** Includes bundled components such as the Small Footprint Common Information Model (CIM) Broker (SFCB), and openwsman, which provides the infrastructure for original equipment manufacturer (OEM) extensions through providers and external accessibility through the Web Services for Management (WS-Management) protocol

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¹ For an extended version of this article, see the Dell and VMware white paper "Systems Manageability of VMware ESXi on Dell PowerEdge Servers," by Viswanathan Balakrishnan, Balasubramanian Chandrasekaran, Sudhir Shetty, Alok Sinha, and Charu Chaubal, April 2009, available at DELL.COM/VMware.

VMware also provides a set of remote tools for managing ESXi systems in the absence of a service console:

- **vSphere Client:** Provides a graphical user interface (GUI) to manage ESX and ESXi hosts; it can be downloaded directly from the ESXi server by pointing a Web browser to the associated IP address and can interface with vCenter Server
- **vSphere Command-Line Interface (vCLI):** Provides for scripted and interactive command-line-based administrative tasks over a secure channel; the commands can enable host configuration, storage and network configuration, maintenance tasks, and patching and monitoring

Key Dell software components include the following:

- **OMSA Web server:** Administrators can use a single instance of the OMSA Web server component on a central management station to manage multiple ESXi systems. The Web browser-based GUI is similar to the standard OMSA interface, providing a familiar tool for administrators who have previously used OMSA to manage PowerEdge servers. Administrators can use it to configure hardware and to view server and storage asset data, server and storage health information, and alert and command logs. The software uses the WS-Management channel to communicate with each ESXi system, with the channel secured using HTTP over Secure Sockets Layer (HTTPS). Administrators should also follow the recommended security guidelines related to certificate management as specified in VMware's *ESXi Configuration Guide*.²
- **Dell provider:** This lightweight component plugs into the SFCB CIM Object Manager (CIMOM), interprets and

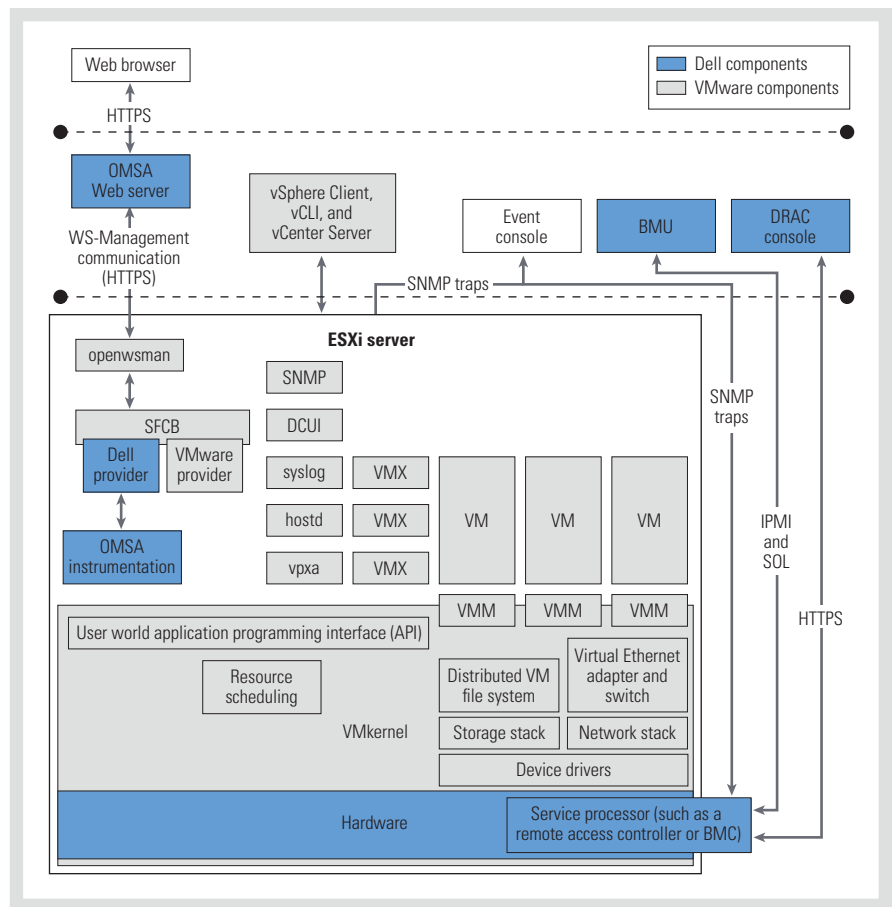


Figure 1. VMware ESXi architecture in Dell PowerEdge servers

authorizes requests from the OMSA Web server component, and invokes the appropriate functionality in the instrumentation stack below it.

- **OMSA instrumentation:** This component provides the core set of hardware monitoring and management services. It is similar to the services present in other OS environments, and enables hardware manageability functions related to monitoring, asset inventory, and configuration.
- **Baseboard Management Controller (BMC) Management Utility (BMU):** The BMU provides remote out-of-band access to the service processor associated with a server. Administrators can use it to run remote Intelligent Platform Management Interface (IPMI) commands to retrieve and clear the

embedded hardware logs, perform power control operations, identify the chassis, and display sensor and power monitoring information. These tools are included in the Dell OpenManage media.

- **Dell Remote Access Controller (DRAC) console:** This GUI can display system health, embedded hardware logs, and sensor information and can provide advanced functionality such as console redirection and virtual media.

In the architecture shown in Figure 1, the event console supports trap reception, event formatting and display, and filtering and performing of actions in response to events. The Dell Management Console, for example, can serve as the event console and handle Platform Event Traps (PETs)

² Available at www.vmware.com/support/pubs/vs_pubs.html.

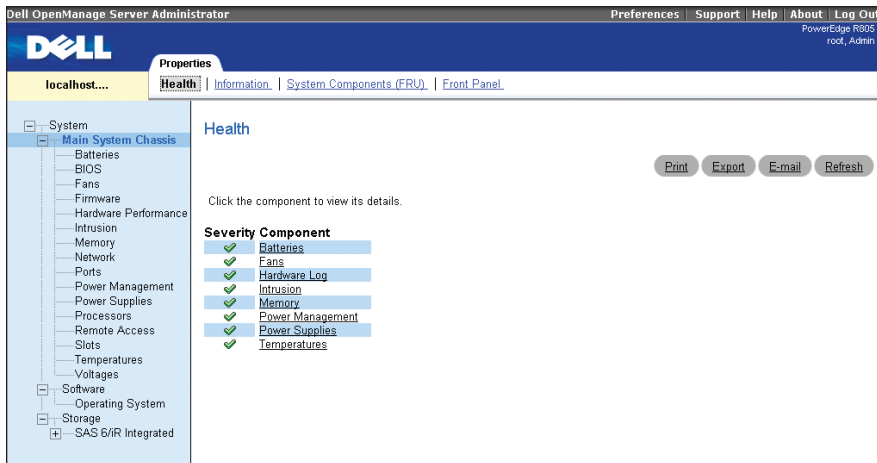


Figure 2. System component health displayed in Dell OpenManage Server Administrator

generated by the service processor as well as traps generated by the VMware software. Administrators must configure ESXi to send Simple Network Management Protocol (SNMP) traps to the system hosting the event console, which they can do using the VMware vCLI utilities.

SYSTEM DEPLOYMENT

Dell PowerEdge servers can be ordered with the VMware ESXi image preinstalled on internal storage such as a Secure Digital (SD) card, USB module, or hard drive, avoiding the need for administrators to install a virtualization platform. When the server boots, the ESXi hypervisor runs automatically and can acquire network settings using Dynamic Host Configuration Protocol (DHCP). If DHCP is not enabled, administrators can use the DCUI for basic configuration, helping simplify the setup process and helping bring the server online quickly. After the initial setup, administrators can use the VMware vSphere Client or vCLI to remotely configure the virtualization layer, including the virtual network and storage devices.

The Dell software components are included as part of the OEM-customized ESXi image, and reside on the boot bank partition of the internal server storage. By default, Dell hardware manageability support is disabled; administrators can

activate this functionality by enabling the CIM OEM providers using either the vSphere Client or vCLI. This change then takes effect after administrators either restart the management agents using the DCUI or reboot the server.³

MONITORING AND ASSET INVENTORY

The OMSA instrumentation services monitor hardware health. The interface can display the global status of the main system chassis and storage subsystem and enables administrators to drill down into specific components (see

Figure 2). Administrators can also view key power monitoring data such as power, cumulative energy use, and peak power consumption.

In addition, OMSA maintains several logs that provide troubleshooting and diagnostics information. The hardware log records information about previously triggered hardware events, and can be viewed using the DRAC interface or the BMU tools. The alert log lists events generated by OMSA, including alerts corresponding to the storage subsystem (see Figure 3). The command log provides an audit trail of commands executed on the server.

Best practices recommend configuring PETs and VMware SNMP traps from the VMware ESXi system to be sent to an event console, which can notify administrators of the events through e-mail or SMS messages. Administrators can then log in to the OMSA Web server or DRAC interface to perform additional troubleshooting and diagnostics.

In addition to monitoring information, the OMSA interface can display asset inventory information about system hardware, software, field replaceable units (FRUs), storage, and remote access devices (see Figure 4). For blade servers, OMSA can also provide information about the modular blade enclosure.

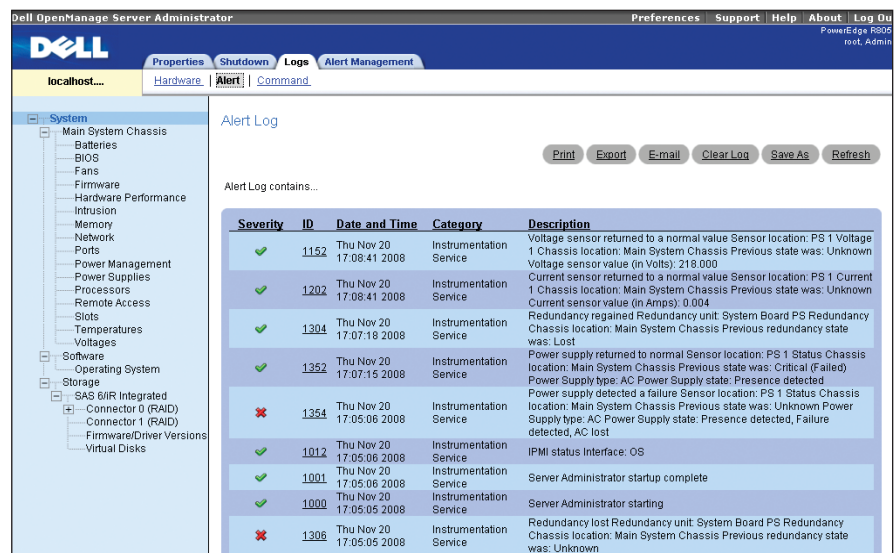


Figure 3. Alert log in Dell OpenManage Server Administrator

³For more information on enabling this configuration, see "Dell OpenManage Server Administrator Installation Guide for VMware ESXi," available at support.dell.com/support/edocs/software/smsom.

Device	Serial No.	Part No.	Revision	Manufacturer	Manufacture Date
System Planar (BMC)	CN717038360117	00X122	A02	DELL	Thu Mar 06 12:00:00 2008
Remote Access Controller (DRAC 5)	WWD3W3	12885P	A02	DELL	Tue May 27 00:00:00 2008
Power Supply 1 (PS 1)	CN1829382P004X	0TP491	A01	DELL	Mon Feb 25 12:00:00 2008
Power Supply 2 (PS 2)	CN1829382P004Y	0TP491	A01	DELL	Mon Feb 25 12:00:00 2008
SAS Controller Daughter Card (Internal Storage)	CN1374085J02KM	0CR679	A03	DELL	Mon May 19 12:00:00 2008
LOM Daughter Card (Mezz_Con)	CN7170383P0109	0M<203	A01	DELL	Tue Mar 25 12:00:00 2008
DIMM_A1	473F3AD1	M3	N/A	Samsung (CE00000000000000)	Mon Apr 28 12:00:00 2008
DIMM_A2	473F3009	M3	N/A	Samsung (CE00000000000000)	Mon Apr 28 12:00:00 2008
DIMM_A3	473F306A	M3	N/A	Samsung (CE00000000000000)	Mon Apr 28 12:00:00 2008
DIMM_A4	473F302B	M3	N/A	Samsung (CE00000000000000)	Mon Apr 28 12:00:00 2008
DIMM_B1	473F3010	M3	N/A	Samsung (CE00000000000000)	Mon Apr 28 12:00:00 2008
DIMM_B2	473F305B	M3	N/A	Samsung (CE00000000000000)	Mon Apr 28 12:00:00 2008
DIMM_B3	473F3031	M3	N/A	Samsung (CE00000000000000)	Mon Apr 28 12:00:00 2008

Figure 4. Asset inventory information in Dell OpenManage Server Administrator

HARDWARE CONFIGURATION

Administrators can use OMSA to perform hardware configuration tasks such as enabling and disabling the system's front panel buttons, configuring the BIOS, setting thresholds for different sensors, configuring remote access devices, and configuring internal and direct attach storage. For example, they can set the thermal shutdown severity level that triggers an emergency system shutdown; configure characteristics of remote access devices such as users, networking, Serial Over LAN (SOL), and serial ports; and configure virtual disks, hot spares, and triggering tasks for storage. There are certain OMSA operations that are not permitted (for example, a subset of the power control operations), as documented in the OMSA user's guide.⁴

BIOS, FIRMWARE, AND SOFTWARE UPDATES

The elimination of the service console has enabled VMware to significantly reduce the number of required patches and updates for ESXi systems. Administrators can update the ESXi image using tools such as VMware vCenter Update Manager, which interfaces with the VMware Web site to download and apply appropriate

patches to the target system. This tool is also integrated with the VMware Distributed Resource Scheduler (DRS) feature to enable patching of ESX and ESXi hosts without requiring downtime.

Dell has integrated functionality into third-party consoles that enables deployment of BIOS and firmware updates. However, the secure, locked-down architecture of ESXi systems does not permit deployment of BIOS and firmware bundles through agent software installed in the host OS. To perform firmware updates, administrators can use the Dell Systems Build and Update Utility, which is included on bootable media with Dell PowerEdge servers. The actual update files are available in the Dell OpenManage Server Update Utility media. Both of these utilities are also available from the Dell support Web site at support.dell.com. Administrators can also use the embedded Dell Unified Server Configurator for supported platforms to perform firmware updates.⁵

Best practices recommend that administrators migrate VMs off a server before performing updates. If the VMware vMotion™ feature is not configured, administrators should power off or suspend the VMs and perform a cold migration.

SIMPLIFIED VIRTUALIZATION MANAGEMENT

VMware ESXi offers a virtualization platform designed for simple installation and deployment, and using VMware and Dell management tools from a central administrative console can enable simplified systems management in these virtualized environments. Dell continues to work with VMware to help further simplify management for virtualization-enabled platforms in future generations of this solution stack and to enhance the seamless manageability of the ESXi platform.

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⁴ Available at support.dell.com/support/edocs/software/svradmin.

⁵ For more information, see "Simplify Management with the Dell Unified Server Configurator Enabled by the Lifecycle Controller," by Shelli Allgood, Anand Narayanan, Hai Phung, and Pritesh Prabhu, in *Dell Power Solutions*, June 2009, DELL.COM/Downloads/Global/Power/ps2q09-20090226-Phung.pdf.