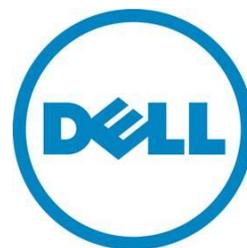# Conquering the Power Challenges
# of Virtualized Environments

Dell improves IT performance and efficiency through deep integration of its UPS portfolio and UPS management software with hypervisors and virtualization management systems.

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Introduction

The IT landscape is being profoundly reshaped by virtualization, whereby a single physical server runs multiple virtual machines, each with its own operating system and application. Instead of provisioning a single, physical server with enough spare capacity (often idle) to support the peak load of a single application, IT managers can now dynamically match available processor power across multiple physical machines to meet the variable demands of application workloads. The same work gets done, but there is far less idle capacity.

Loading multiple low-usage machines as virtual machines (VMs) onto one physical host enables the physical infrastructure to work at a much higher utilization rate. On a non-virtualized platform with a single operating system (OS), the average server central processing unit (CPU) runs at only 10 to 15 percent of capacity. With virtualization, that figure can jump to as much as 80 percent[1].

With higher physical server hardware utilization, the IT infrastructure delivers more computations or services per watt of energy, per dollar of IT investment, per U of rack space, or per almost any other efficiency metric you can name. It is no wonder that virtualization is taking hold in organizations of all sizes, including small to mid-sized businesses (SMBs).

The power challenges of virtualization

In addition to all its advantages, virtualization brings some unique challenges—all of which are outlined in the following sections.

Physical machines hosting more business-critical services

Each physical machine (host) would typically support 20–40 VMs. That means a power problem for one host could easily bring down many important services.

As a result, rack-based Uninterruptible Power Supplies (UPSs) can now carry as much responsibility as large data-center UPSs (100kW and up) would carry in conventional IT environments. This puts a very high reliance on a product that has not been typically thought of as an integral part of the managed IT infrastructure.

Do you feel confident that your current power protection scheme is as robust as it should be?

Unlike workloads, the power infrastructure is fixed

Virtualization makes it possible to deploy, move, or clone a service or application from one platform to another at any time, even while it is running. Do you have the

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[1] Information publicly available on VMware.com, as of October 5, 2011.

Traditional power monitoring and management approaches—which may have been sufficient for pre-virtualization needs—no longer meet the complex requirements of virtualized environments.

The traditional approach to UPS power management is: *if there is a loss of power, start shutting down the server.*

That has worked well for years, but virtualization challenges the concept of what a "server" is, or indeed, where in the world the server is located.

capability to track the whereabouts and power protection status of VMs as they are migrated among hosts?

Virtualization adds management complexity

Rather than just being concerned with one operating system on one physical server, virtualization brings the requirement to manage servers at multiple levels: at the level of the VMs, at the level of the hypervisor that enables VMs to interact with the host hardware, and at the level the of host hardware.

Additional complexity comes with clustered virtualization on multiple physical host servers. In this scenario, VMs can be moved to another host server using advanced hypervisor management functions—such as VMware® Distributed Resource Scheduler (DRS) and vMotion®—to provide load balancing between physical hosts or to dynamically allocate resources.

These capabilities introduce new requirements for managing power, such as the need to control and protect VMs during a power event, to keep track of VM power profiles, and to update UPS software agents and firmware.

Many of the tools being used to perform these tasks today require IT administrators to have experience with command-line programming, as well as the time to program and debug solutions. In the virtualized environment, you have to wonder, how much time will you spend managing power instead of managing IT?

Limitations of traditional power management

As we have listened to our customers, Dell has noticed several consistent limitations faced when using traditional power management software. We would like to analyze these challenges in the following sections.

Installing UPS software on each VM

Some UPS management software does not integrate with the hypervisor, and must be installed on every virtual machine. For instance, a typical mid-sized business with 100 VMs would have to install and configure UPS management software 100 times. Each VM's response to power events is configured separately. As IT installations grow larger, this becomes quite a tax on the business.

Figure 1.   Power management software installed on each VM
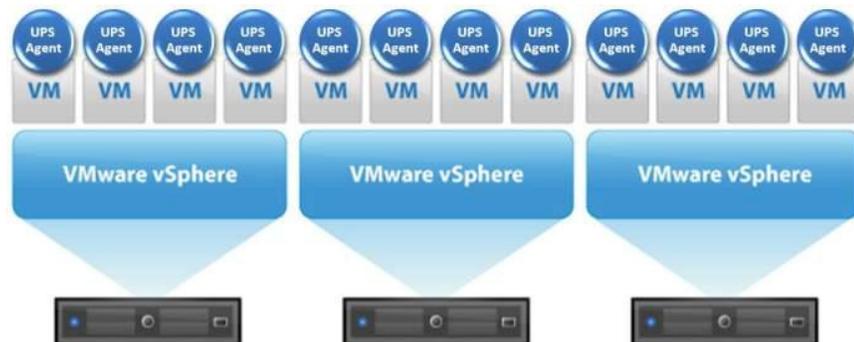
Previous challenges of installing UPS software

UPS management software that is not deeply integrated with the hypervisor management system will typically only execute shutdown of virtual machines, leaving hypervisors to an ungraceful shutdown, IT users without service, and a business without productivity.

UPS management software for virtualized solutions can be challenging to install, may lack a graphical user interface, and often requires a reasonable grasp of programming, command line interfaces and network troubleshooting.

For example, if you wanted to install UPS software on a VMware ESXi™ virtualization platform, it may not involve a simple drag-and-drop, point-and-click process. At the system-management level, you are presented with an ASCII-character interface that would send most administrators to the manuals for help.

The process may require you to go into the hypervisor through the vSphere Management Assistant (vMA), issue a command to change user access rights to the install file, promote yourself to administrator rights, set control access rights to the file, and change the read/write access for administrators, users, and guests. At this point, you would have not even started installing the application yet.

Power profiles had to be configured separately for each VM

In addition to installing an instance of the software on each VM, users may have needed to configure the shutdown profile for each VM individually, a process that can take 5-10 minutes per VM. If you have 200 VMs, this installation and configuration process could consume more than two full workdays.

Every time power conditions change (for example, you add an external battery module or want to change server start-up and shutdown protocols) you have to venture into the command-line world and update that VM power profile accordingly. As a result, maintaining a VM power profile inventory on a growing network has been laborious and prone to error.

During a power failure, users could still lose services

Where there is no integration with the hypervisor, the power management software on each VM can manage graceful shutdowns at the VM level, but no VM can shut down the hypervisor and physical host. If the UPS runs out of battery power during an extended power outage, the result is a non-graceful power-off of the host.

What if you have a backup location, such as a backup server in an N+1 configuration or a disaster recovery site, to which those VMs could be migrated to avoid costly downtime? In that case, you would not want VMs to shut down when the power fails; you would want to move them to the backup host.

Traditionally, there has been no method to do this. The VMs simply shut down when the UPS battery runs low. Service to users is lost, negating your investment in a disaster recovery location. Only the most advanced UPS management software can integrate with a hypervisor to such a degree as to initiate this VM movement in the event of power problems.

Every add or change could require a new UPS software license

Dell UPS Monitoring and Control Software

- Saves work in progress and gracefully shuts servers down

- Local and remote monitoring/ notification of power status

- Single management interface for monitoring multiple servers and UPSs

- Supports group distribution of firmware upgrades

- Simple, consistent interface on all operating systems

- Quick to install, simple to use, and easy to update

With some UPS vendors, you are charged according to how many servers (physical or virtual) you want to monitor or control, and through which type of connectivity (USB or network). When you consider that even a mid-sized company can have hundreds of VMs, this can mean a high price in license fees and administrative complexity.

Furthermore, when a new version of UPS power management firmware is released, typically you would have to download a special firmware upgrade tool, learn how to use it, and upgrade each device individually.

The cumulative result of these limitations is a power environment that is unnecessarily complex and time-consuming to manage, with notable vulnerabilities.

Table 1.   Limitations of the traditional UPS power management approach

Traditional UPS power management approach
• Treats each VM as a traditional server • Requires installation and configuration of UPS agent on each VM (not on hypervisor)
Limitations
• Time consuming, inefficient (multiple instances), and impractical for large installations • Does not use advanced benefits of virtualization, such as server migration and power profiling • No control over the hypervisor and no ability to safely shut down the physical host • Difficult to track individual settings and configurations across multiple VMs

At Dell, we believe these limitations are unacceptable in a world where virtualization is becoming so prevalent.

Changing the game for UPS power management

Dell has redefined the way power protection is managed in virtualized IT environments. Dell UPSs deliver the needed information about power consumption, power events, available battery runtime, alarm conditions, and more. Through local and remote UPS management software interfaces, you can get the detailed and aggregated information needed to measure power usage, prevent tripped circuits, understand where new systems and applications can be deployed, balance loads, and diagnose power problems.

The Dell UPS power management suite[2], launched in 2011, includes two complementary and integrated offerings:

The Dell UPS Local Node Manager (ULNM):

- Gracefully shuts down computers, virtual machines or servers, and network devices powered by a Dell UPS, saving all work-in-progress and ensuring data integrity
- Enables authorized administrators to view power status and manage shutdown configurations from any PC with a web browser

The Dell Multi-UPS Management Console (MUMC):

- Enables remote monitoring and configuration of multiple UPSs and ULNM agents across the network from a single interface—through any PC with a web browser or through your VMware vCenter™ dashboard
- Provides instant access to critical information, such UPS battery condition, load levels, battery runtime, and kilowatt hours (kWH)
- Integrates with hypervisor central controllers to manage multi-host virtualized installations
- Triggers migration applications to transparently move virtual machines to an available server on the network, for data integrity and zero downtime
- Enables safe shutdown of servers, even servers in clusters running vCenter
- Simplifies software and power profile management by automatically detecting devices on the network; tracking equipment moves, adds, and changes; and supporting mass firmware upgrades

Configurations with just one physical server and one UPS would install one ULNM agent to support graceful server shutdown during a power outage. Multi-server installations would have a local ULNM agent on each physical server and the MUMC software on an administrator's desktop or laptop PC to monitor and manage the status of multiple virtualized hosts and VM migration during a power event. Installations with multiple hypervisors and a centralized hypervisor manager (such as vCenter) typically only require one installation of MUMC with no software installed on the local servers. The MUMC manages each hypervisor through the hypervisor manager.

Unique differentiators for virtualized environments

Dell UPS power management tools seamlessly integrate with VMware vCenter Server, Microsoft® System Center Virtual Machine Manager (SCVMM), and Citrix® XenServer™ virtualization software (ESXi, Hyper-V®, and XenServer hypervisors) for graceful

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[2] Release 01.02.0006 of Dell UPS power management suite is compatible with all Dell single-phase UPS products, from 500W to 5600W.

Dell UPS management software enables you to better manage and protect IT assets and make smarter decisions about power usage, computing devices, and redundancy strategies.

COMMENTARY

shutdown of VMs in the event of a power problem. The Dell UPS software also supports live migration of VMs for VMware (vMotion) and Hyper-V (Live Migration).

Dell UPS power management software addresses the prevailing challenges and limitations of managing power in virtualized environments.

Table 2.   Advantages of Dell UPS power management

| The Dell UPS power management approach |
| --- |
| • UPS agent integrated with hypervisor (single host) or central management server (multi-host)
• Power conditions reported to a single location (hypervisor/system manager controls VMs)
• No UPS software agent required on the VMs |
| **Advantages** |
| • One-time installation, very quick and simple

• Centralized management for VM shutdown and start-up profiles; all settings in one place

• Ability to use advanced technologies such as VMware vMotion and Hyper-V Live Migration

• Safe shutdown of hypervisor and host following complete VM move or shutdown

• Improved availability for multi-host sites using UPS-triggered VM moves |

No need to install the UPS software on each VM

For single-host server installations, you would only need to install the ULNM software on the hypervisor, such as VMware's ESX, ESXi, or Microsoft Windows Server® 2008 (for Hyper-V). ULNM is then used to manage graceful shut down of VMs and the host if required. Alerts can also be sent from the ULNM installations alerting the data-center manager of any critical power issues or warnings.

For multi-host server installations, loading ULNM software onto the physical host systems is not required, as long as vCenter or SCVMM is used to manage the cluster of servers. MUMC is then used to provide commands for host server (and VM) graceful shutdown, as well as provide commands for live migration of the VMs.

Proactive maintenance mode is preferable to using HA (High Availability) because it allows proactive choices of what to do with VMs instead of relying on a catastrophic VM failure recovery process.

Organizations that use VMware HA might argue that if the host fails due to a power outage, it does not matter because the VMs will automatically be recreated from live backups on another host that is not in distress. While this is true, the user experience is not the same.

Using HA and fault tolerance capabilities, there is a significant reduction in number of customer requests serviced. When using maintenance mode to migrate the VMS to a safe host, the disruption may last longer but it is less pronounced. Users have almost unaffected access to their services.

Figure 2. **An agent required only on hypervisor or VM management platform**
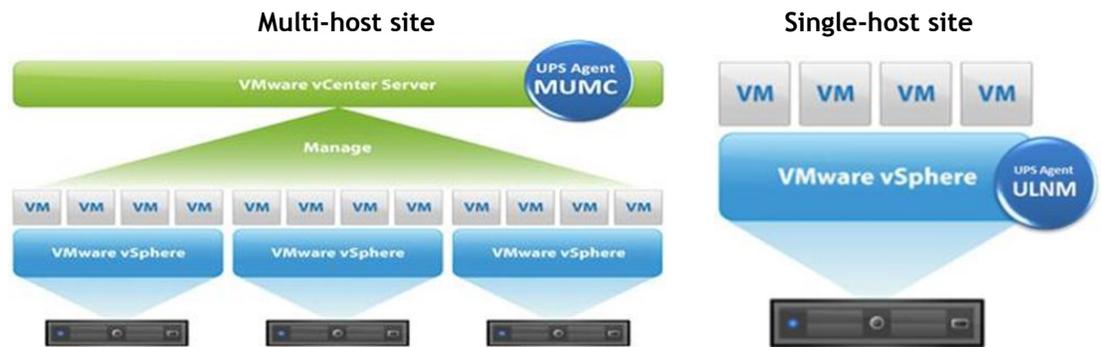
Installing the UPS software is point-and-click easy with a graphical user interface. For example, when installing Dell UPS management software on VMware vCenter, you would use a Microsoft Windows® client with a simple, familiar graphical interface to connect to, configure, and manage multiple vSphere servers. No command-line programming is required. Installation is a straightforward, do-it-yourself process.

Power profiles synchronized with the virtual network infrastructure

Dell uses a simple Web interface to automatically synchronize access parameters for the management software and network access card. You can also define shutdown scripts, for instance, to close down an SQL database before the actual physical server shuts down.

As shown in Figure 3, configuring server shutdown profiles is easy with a graphical interface and automatic synchronization of access parameters. In this example, the computer is connected to Load segment #1 of the UPS. You can select the load segment you wish to shut down from the drop-down menu.

Figure 3. **Configuring server shutdown profiles**

The Power source field lists the UPS model that powers this computer.

Dell UPS models allow you to independently control groups of receptacles on the rear panel of the UPS.

Complete these three fields to define the shutdown characteristics for the connected load.

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Graceful shutdown of virtualized servers

UPS internal batteries (and optional external battery module) provide backup power to gracefully shut down servers if the power goes out. During an extended power outage (or scheduled shutdown), the Dell UPS management software instructs the hypervisor to migrate, shutdown or suspend each VM before finally shutting down the host server.

In a power failure, VMs can automatically be migrated

In virtualized environments, it is usually more desirable to ride through outages instead of shutting down and restarting a high number of VMs and the critical applications they support. Dell makes this possible.

When the UPS battery level reaches a defined value, the MUMC automatically triggers a request to the virtualization platform's migration application— VMware vMotion and Microsoft Live Migration—to move the VMs to a safe host. Users do not lose service because the VMs are still functioning on a backup or disaster recovery host.

Should the power failure continue until the UPS battery is exhausted, the hypervisor and host will perform a graceful shutdown. When power returns, the UPS powers up, the host powers up, the hypervisor powers up, and the hypervisor will automatically take back control of its original VMs.

For example, in a VMware virtualized environment, the UPS tells the MUMC when the battery is low. The MUMC issues a command to the VMware Distributed Resource Scheduler (DRS) to use vMotion to move the VMs to safe hosts. Once the VMs have been moved, the UPS safely shuts down the vSphere virtualization platform and the physical host. This process is seamless to users because services continue to run on the backup server. When power returns, the UPS restarts the physical server, DRS and vMotion move the VMs back to the original host, and the system is restored to normal.

Free UPS monitoring and shutdown software for unlimited servers

Dell's local node management software (ULNM) is always free, no matter how many UPSs, servers, or VMs you are managing. Dell's management console software (MUMC) is free for any number of ULNM installations, servers, VMs and up to 32 UPSs. You only need a license upgrade to monitor and manage more than 32 UPSs.

For example, suppose you had 30 UPSs, each supporting 10 servers, and each running the ULNM agent. The MUMC software would be managing the VMs on 300 physical servers, but since the software is licensed per UPS and not per server, no license would be required.

Firmware for multiple devices can be upgraded with one click

Upgrading the firmware is simple as well. Just upload the firmware package into your existing UPS management software and deploy it to multiple devices with one click, all managed through the familiar UPS interface.

Dell MUMC can monitor UPSs from other vendors

Customers that use other vendors' UPSs will likely see the benefit of switching to Dell UPSs to take advantage of advanced power management capabilities. However, they

Now IT managers can not only control the hardware's response to power disturbances, but also automatically move VMs from distressed environments to recovery locations that are operating under normal conditions.

With the ULNM interface, you can get at-a-glance views of power status and trends, or view detailed information about UPS power status, battery runtime, power information, and graphical representations of metrics over time.

can retain their previous investment in non-Dell UPSs and still benefit from unified monitoring.

Dell MUMC software can monitor many types of UPSs that have a network card installed (or Dell UPSs using a network card or USB communications), providing an overview of all IT and power systems in a multivendor environment from one unified interface. For example, if you have a mix of Dell and APC™ UPSs, the APC PowerChute® software could run on the local server to manage shutdown, while the Dell MUMC is used to monitor the status of all UPSs in the network— Dell and non-Dell UPSs—from one central management point.

Intuitive, easy-to-use graphical interfaces

Both the ULNM and MUMC software applications have intuitive, Windows-based graphical interfaces. The interface will look the same on Windows or Linux® platforms, because the application actually opens in a web page. The displays use familiar Windows-based conventions, such as pull-down menus, dialog boxes, radio buttons, right-click to drill into detail, and drag-and-drop functions.

Figure 4. **UPS Local Node Manager interface**

Define where alerts should be sent and under what conditions. In a simple dialog box, you can define or edit default alarms, SMTP email server information, and specifications for alarm frequency and severity.

Access configurations, parameters, setup, events and logs

Displays UPS information, power status, battery runtime

Measures power information

Auto discovery adds UPSs through quick scan of USB and IP local subnet, or address scan through IP local and different subnet

Graph power metrics over time. Hover over the graph to view additional details.

Customize view by dragging and dropping info windows
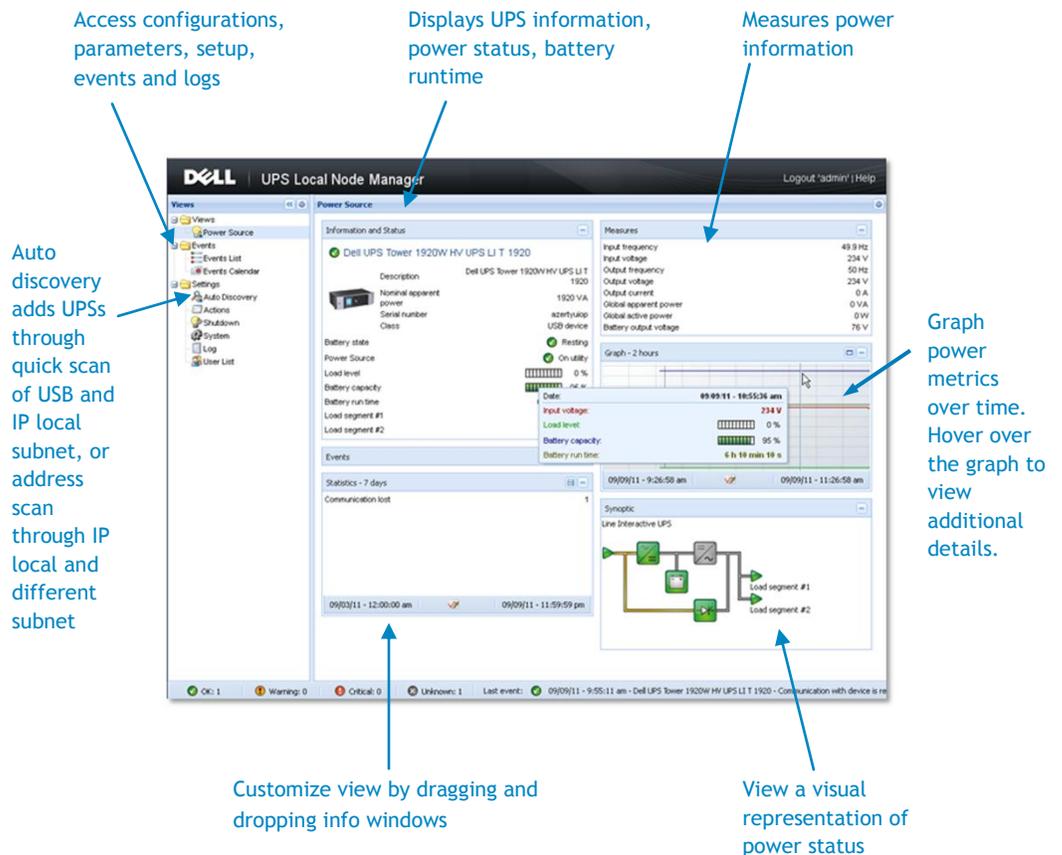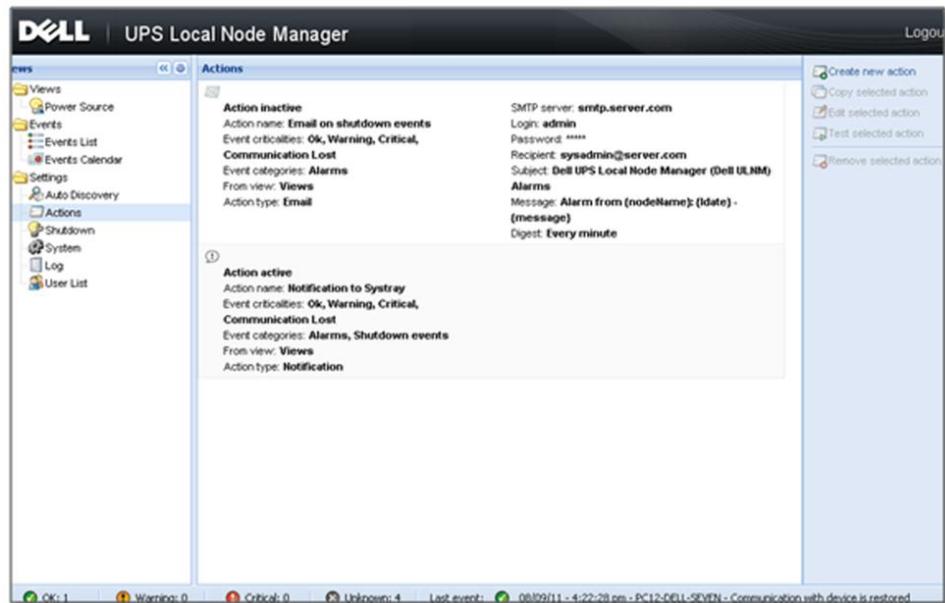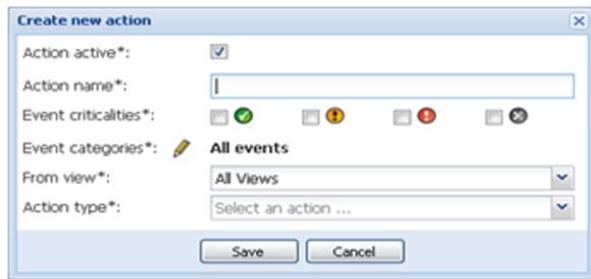
View a visual representation of power status

Figure 5. Defining alerts using the ULNM interface

Step 1: Choose Actions from the menu.

Step 2: Edit default alarms and enter SMTP email server info, alarm frequency, and severity information.

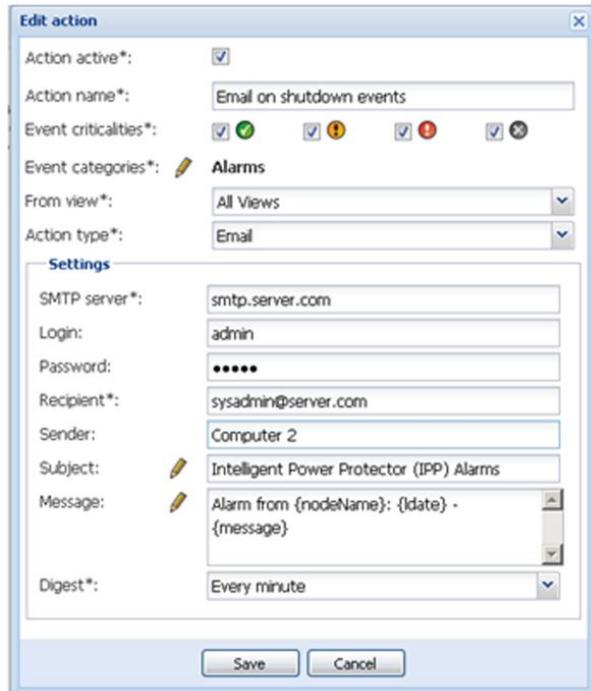Step 3 (optional): Create a custom alarm for any metric.

Figure 6. **Dell Multi-UPS Management Console**

Using the MUMC Console, you can view status and events for all servers running ULNM software from anywhere.

Manage the properties of UPSs, software agents, or network access cards from a single panel. For each node, you can right click and determine access parameters. The changes you make in the software will automatically synchronize to the network access card.

Background: Customize the background with any jpg file. Use a network map, building plan or regional office map locations.

Node map: View all UPSs and servers running ULNM. Drag and drop to locate geographically.

Drill-down: Hover over any device to see status and ID.

**Events summary:** See a summary of all events on all UPSs and servers. See server shutdown profiles.

Figure 7. **Management capabilities of MUMC**

Nodes upgrade: Enable mass firmware and configuration upload options.

Nodes settings: Manage any node through MUMC. You can change the IP or performance setting of the UPS and change the shutdown profiles of the server through ULNM.

Edit panel: Edit properties of devices such as the UPS Network Management Card.
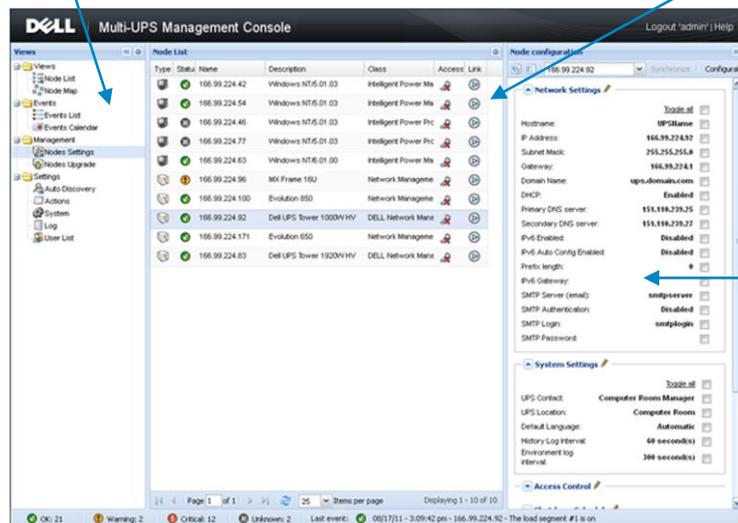
Conclusion

Dell differentiators for virtualized IT environments

- Manage VM shutdown without installing the software on each VM

- Install and manage the software in an intuitive, graphical environment

- Manage VM start/stop profiles through vCenter plug-in (VMware only)

- Manage all VMs across a network from a single management interface

- Use advanced virtualization functions, such as vMotion and Live Migration, to move VMs to a recovery site in the event of power failure

Today's requirements for computing efficiency, availability, and reliability are well served with virtualization technologies. Without seamless integration of power management into this environment, the advances of virtualization are somewhat muted, and many of the potential benefits are lost.

In virtualized IT environments—with each UPS serving so many VMs—there are some important questions to be answered: Is traditional power management software as robust as it needs to be? How are hundreds of VMs handled in a power failure event? How do you keep track of multiple UPS agents and potentially hundreds or thousands of VM power profiles?

Virtualization is already complex; UPS software should not make it worse. Dell significantly reduces the complexity, workload, and skill-set requirement associated with managing power in a virtualized infrastructure.

Dell's UPS power management software integrates with the most widely used hypervisors to manage VMs. With this deep integration, users can manage all VMs across a network from a single management interface and use advanced virtualization functions such as vMotion and Live Migration to move VMs to a safe host during a power event. Instead of just shutting down services, Dell UPS software can be an active participant in maintaining services by actually triggering the request for VM migration.

No software license or fee is required to monitor up to 32 UPSs, and no license is required to manage shutdown for an unlimited number of VMs and servers. Reflecting the reality of a multi-vendor world, the software is also vendor-neutral, providing a unified view to monitor most manufacturers' UPSs.

Learn more

For detailed information on the Dell UPS portfolio including up-close views of key features, visit Dell.com/us/business/p/dell-online-rack-ups/pd.

Visit DellUPS.com to find out more about how Dell ULNM and MUMC software can redefine power management in high-availability IT environments, particularly where virtualization is used. All Dell single-phase UPS products from 500W to 5600W are compatible with this new software. Download the software and start taking advantage today.