

# REDUCING POWER COSTS BY MIGRATING LEGACY SERVERS TO A VIRTUALIZED DELL POWEREDGE 2950

BY SCOTT HANSON

**Virtualizing legacy servers nearing the end of their life cycle can help reduce power costs while maintaining similar levels of performance. Recent Dell tests show that migrating legacy servers to a virtualized Dell™ PowerEdge™ 2950 can help reduce average power use by approximately 2 kW, potentially saving more than US\$6,000 over a three-year period.**



**S**erver consolidation is a key advantage of virtualization in enterprise data centers. By migrating physical systems to virtual machines (VMs) on a single server, enterprises can efficiently utilize hardware resources and help reduce power costs while simplifying management for IT staff.

As legacy servers reach the end of their life cycle, enterprises should consider consolidating these systems as VMs on virtualized servers rather than replacing them with new physical servers. To help demonstrate the advantages of this approach, in July 2007 Dell engineers set up three legacy servers—a Dell PowerEdge 2650, IBM® eServer xSeries 345, and HP ProLiant DL380 G3—and measured their performance and power use. They then converted these systems to VMs on a Dell PowerEdge 2950 server running VMware® Infrastructure 3, increased the number of VMs to maximize resource utilization, and compared the power use of this virtualized server with the average power use of a comparable number of legacy physical servers. The results show that, on average, such a consolidation could help reduce power use by approximately 2 kW, and that consolidating multiple HP ProLiant DL380 G3 servers could provide savings of more than US\$6,000 in power costs over a three-year period.

## Hardware and software configuration in the test environment

The tests focused on consolidating approximately three-year-old Dell PowerEdge 2650, IBM eServer xSeries 345, and

HP ProLiant DL380 G3 servers onto a Dell PowerEdge 2950 server running VMware Infrastructure 3 virtualization software. The hardware was chosen to be representative of servers that may be nearing the end of their life cycle, to help demonstrate how their existing workloads can be easily and efficiently migrated to a current-generation Dell PowerEdge server.

Figure 1 shows the hardware configuration for each server in the test environment. The test team disabled Intel® Hyper-Threading Technology on all of the servers, and downloaded and installed the latest firmware and driver versions available on the vendor Web sites. The hard drives in each server were configured in a RAID-5 array with no hot spare.

As shown in Figure 1, the test team set up each of the three legacy servers as similarly as possible: each was configured with two Intel Xeon® processors DP at 3.06 GHz with a 1 MB cache and a 533 MHz frontside bus, and had 2 GB of RAM. Each of these servers ran the Microsoft® Windows® 2000 Server OS with Service Pack 4 (SP4). The Dell PowerEdge 2950 used for consolidation was configured with two quad-core Intel Xeon X5355 processors at 2.66 GHz with an 8 MB level 2 (L2) cache and a 1,333 MHz frontside bus, and had 12 GB of RAM.

To help evaluate server performance and scalability, the test team used the Dell DVD Store Version 2 (DS2) e-commerce test application, which functions as a database test or as a stress tool. DS2 includes a back-end database component, a Web application layer, and driver programs, and includes advanced database features such as transactions, stored

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procedures, triggers, and referential integrity. The test team used the Microsoft SQL Server™ 2000 Enterprise Edition database platform with SP4 to run the DS2 application. DS2 is freely available under the GNU General Public license at [linux.dell.com/dvdstore](http://linux.dell.com/dvdstore). For more information, visit [www.delltechcenter.com/page/DVD+Store](http://www.delltechcenter.com/page/DVD+Store).

To help ensure that the software stack remained consistent between the physical servers and VMs, the test team used VMware Converter 3 to migrate the servers to VM images. This robust, enterprise-class migration tool can be run on a wide variety of hardware and supports many common Microsoft Windows operating systems, enabling administrators to easily convert local and remote physical servers, third-party VM formats (such as Microsoft Virtual Server), and physical server backup image formats (such as Symantec Backup Exec System Recovery) to VMware VMs and perform other conversion and recovery tasks. A demonstration of the migration process used for the Dell tests is available at [www.delltechcenter.com/page/Demonstrations](http://www.delltechcenter.com/page/Demonstrations).

### Test results: Power use and cost savings

The Dell tests comprised three parts: testing the physical servers, testing the VMs, and calculating power use and cost savings.

### Testing the physical servers

To test the physical servers, the test team used DS2 to increase the workload on each server until the processor utilization was approximately 30 percent. They then varied the DS2 parameters across multiple runs until they found a set of parameters that provided comparable processor utilization on each server: in this case, two

|                     | Dell PowerEdge 2650   | IBM eServer xSeries 345                       | HP ProLiant DL380 G3                          | Dell PowerEdge 2950  |
|---------------------|---|---|---|--|
| Processors          | Two Intel Xeon processors DP at 3.06 GHz                      | Two Intel Xeon processors DP at 3.06 GHz      | Two Intel Xeon processors DP at 3.06 GHz      | Two quad-core Intel Xeon X5355 processors at 2.66 GHz              |
| Processor cache     | 1 MB  | 1 MB  | 1 MB  | 8 MB   |
| Frontside bus speed | 533 MHz   | 533 MHz                                       | 533 MHz                                       | 1,333 MHz  |
| Memory              | 2 GB (four 512 MB PC2100 dual in-line memory modules [DIMMs]) | 2 GB (four 512 MB PC2100 DIMMs)               | 2 GB (four 512 MB PC2100 DIMMs)               | 12 GB (six 2 GB PC5300 DIMMs)                                      |
| RAID controller     | PowerEdge Expandable RAID Controller (PERC) 3/Di              | IBM ServeRAID-5i                              | HP Smart Array 5i+                            | PERC 5/i   |
| Internal disks      | Three 73 GB, 10,000 rpm, 3.5-inch SCSI drives                 | Three 73 GB, 10,000 rpm, 3.5-inch SCSI drives | Three 73 GB, 10,000 rpm, 3.5-inch SCSI drives | Five 73 GB, 10,000 rpm, 2.5-inch Serial Attached SCSI (SAS) drives |
| Power supplies      | Dual redundant  | Dual redundant                                | Dual redundant                                | Dual redundant   |

Figure 1. Hardware configuration in the test environment

threads and a think time of 0.015 seconds. Finally, they ran the DS2 application three times (for one hour each time) on each physical server and averaged the results, recording performance (in orders per minute [OPM]), power use (in watts), and average processor utilization. Figure 2 summarizes the results.

Although the purpose of these tests was not specifically to compare the physical servers, it is interesting to note that the Dell PowerEdge 2650 provided the highest performance of the three, while the HP ProLiant DL380 G3 had the highest power consumption.

### Testing the virtual machines

The test team next migrated each physical server to a VM on the Dell PowerEdge 2950

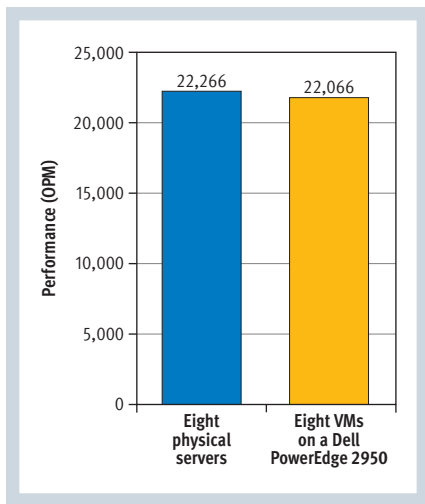
using VMware Converter 3, then used the average OPM across the three physical servers as the baseline performance that the VMs had to achieve. After varying the DS2 parameters across several test runs, they determined that using two threads and a think time of 0 seconds yielded approximately 2,800 OPM from each VM. Because the migration to a virtualized environment eliminated hardware-based performance differences between the three systems,

|                         | Performance  | Power use | Processor utilization |
|-------------------------|--------------|-----------|-----------------------|
| Dell PowerEdge 2650     | 3,041.33 OPM | 290.67 W  | 30.82%                |
| IBM eServer xSeries 345 | 2,450.67 OPM | 278.67 W  | 28.91%                |
| HP ProLiant DL380 G3    | 2,858.00 OPM | 346.00 W  | 33.20%                |
| Average                 | 2,783.33 OPM | 305.11 W  | 30.98%                |

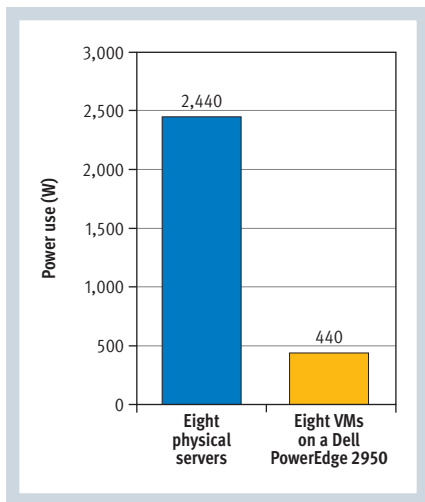
Figure 2. Average performance, power use, and processor utilization results for the physical servers

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**Figure 3.** Average performance extrapolated for eight physical servers compared with the performance of eight virtual machines on a Dell PowerEdge 2950



**Figure 4.** Average power use extrapolated for eight physical servers compared with the power use of a single virtualized Dell PowerEdge 2950

the three VMs were essentially identical, and running the DS2 application on each of them yielded the same OPM results.

The test team then increased the number of VMs running on the PowerEdge 2950 until the processor utilization measured in VMware ESX Server was approximately 80 percent, which resulted in the consolidation of eight workloads on this server. Extrapolating the

average performance of the physical servers shows that eight of these servers could process approximately 22,266 OPM. When the test team ran the DS2 application on the eight VMs, they processed a total of 22,066 OPM, which is within 1 percent of the projected average performance of the physical servers (see Figure 3).

In terms of power, extrapolating the average power use of the physical servers shows that eight physical servers would use approximately 2,440 W. The virtualized Dell PowerEdge 2950, in contrast, used only 440 W—a savings of 2 kW, resulting in a system more than five times more energy efficient than eight of these physical servers (see Figure 4). Comparing the virtualized Dell PowerEdge 2950 with eight HP ProLiant DL380 G3 servers, which would have the highest power use of the three servers, at 2,858 W, shows that the virtualized PowerEdge 2950 would be more than six times more energy efficient than eight of these physical servers.

### Calculating power use and cost savings

Reducing power use is not just an abstract benefit—controlling power costs can be critical to building an efficient IT infrastructure. In the test environment, the virtualized Dell PowerEdge 2950 saved 2,418 W compared with what eight HP ProLiant DL380 G3 servers would consume. Power is sold by the kilowatt-hour (kWh). Assuming that these servers would remain in use for three years and run constantly during that time, the total difference in power use between the virtualized PowerEdge 2950 and eight HP ProLiant DL380 G3 servers over that period would be 63,545.04 kWh.

The average price for commercial electricity in the United States as of June 2007 was US\$0.0992/kWh.<sup>1</sup> Multiplying this price by the three-year difference in power use gives a total cost savings over that period of US\$6,303.67.

### Efficient consolidation to a virtualized Dell PowerEdge server

Using a tool such as VMware Converter 3, administrators can easily migrate physical

servers to VMs without disrupting the existing environment. As demonstrated by the Dell tests, consolidating eight of the legacy servers described in this article to a Dell PowerEdge 2950 server running VMware Infrastructure 3 could help reduce power consumption by approximately 2 kW; based on these results, consolidating eight HP ProLiant DL380 G3 servers could save US\$6,303.67 in power costs over a three-year period. Importantly, enterprises can take advantage of these savings while still maintaining similar levels of performance. As virtualization becomes increasingly mainstream, this type of consolidation can provide an efficient way to reduce power costs for enterprises with physical servers nearing the end of their life cycle. [⚡](#)

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<sup>1</sup>"Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, June 2007 and 2006," by the Energy Information Administration, U.S. Department of Energy, in *Electric Power Monthly*, September 2007, [www.eia.doe.gov/cneaf/electricity/epm/tables\\_6\\_a.html](http://www.eia.doe.gov/cneaf/electricity/epm/tables_6_a.html).