

# SAP ERP PERFORMANCE AND TCO: DELL POWEREDGE R910 VS. HP PROLIANT DL385 G7

## Dell delivers **13% lower TCO\*** and **22% better SAP® performance\*\***

\*We compared five Dell PowerEdge R910 servers to six performance-equivalent HP ProLiant DL385 G7 servers. \*\*We compared one Dell PowerEdge R910 server to one HP ProLiant DL385 G7 server.



Dell™ PowerEdge™ R910 server  
with Intel® Xeon® Processors X7560

HP ProLiant DL385 G7 server with  
AMD Opteron™ processors Model 6174

### OUR FINDINGS

Intel Xeon Processor X7560-based Dell PowerEdge R910 high-performance servers, running in a dual-socket configuration, can provide significant savings and performance benefits over a comparable configuration of AMD Opteron processor Model 6174-based HP ProLiant DL385 G7 dual-socket servers.<sup>1</sup> Based on tests in our labs with an SAP Enterprise Resource Planning (ERP) workload, the lower hardware costs of five Dell PowerEdge R910 servers, along with lower software, management, and facilities costs, provide a 3-year total cost of ownership (TCO) advantage over a performance-equivalent configuration of six HP ProLiant DL385 G7 servers.

### OUR PROCESS

We measured server performance using a representative SAP ERP workload that simulates a customer order scenario. We ran the workload on the two server models, each of which was running SAP ERP and Microsoft® Windows Server® 2008 Enterprise Edition with Microsoft SQL Server® 2008. We used the results to identify performance-equivalent configurations of the two server models: five Dell PowerEdge R910 servers and six HP ProLiant DL385 G7 servers. We calculated the 3-year TCO of both configurations using hardware and support prices and power consumption data from the Dell and HP Web sites, and our own cost estimates for provisioning, facilities, software, and server management.

<sup>1</sup> Source: Principled Technologies, Inc., "SAP ERP performance and TCO: Dell PowerEdge R910 vs. HP ProLiant DL385 G7," a September 2010 report commissioned by Dell Inc.



## PROJECT OVERVIEW

We estimated costs for a hypothetical enterprise planning to purchase either Dell PowerEdge R910 servers or a performance-equivalent quantity of HP ProLiant DL385 G7 servers. The hypothetical enterprise is seeking a solution that provides the lowest 3-year TCO and hopes to realize savings through lower costs in the following areas: hardware, software, facilities, and management. The analysis in this report considers both acquisition costs and 3-year operating costs of each server.

As a first step, we tested the SAP ERP performance of the following servers:

- Intel Xeon Processor X7560-based Dell PowerEdge R910 server running in a dual-socket configuration
- AMD Opteron processor Model 6174-based HP ProLiant DL385 G7 server

The goal was to determine which server provides better performance running an SAP ERP workload that simulates a customer order scenario in a two-tier configuration, with the database software and SAP ERP layers residing on the same server. In this scenario, we modeled two of the main tasks that an ERP system carries out: sales functionality and order distribution. The capability to process more orders in a limited time window is preferable, and we measure this capability in workload operations per hour. We installed Microsoft Windows Server 2008 Enterprise Edition, Microsoft SQL Server 2008 Enterprise Edition, an SAP ERP 6.0 central system, and multiple SAP ERP 6.0 dialog instances on each server. For each server, our goal was to achieve as much above 90 percent CPU utilization as possible, while still maintaining an acceptable response time, between 0.8 and 1 second. We configured one SAP central system and 11 SAP dialog instances on each system, and adjusted CPU affinity on each platform to provide optimal throughput and response time.

We then estimated costs for a hypothetical enterprise planning to purchase either Dell PowerEdge R910 servers or a performance-equivalent configuration of HP ProLiant DL385 G7 servers, using the performance test results to define the two configurations.

## WHAT WE TESTED

We measured server performance using a customer-provided SAP ERP workload that models thousands of users creating customer orders with multiple line items, delivery processing, transfer of goods, and subsequent invoicing. We installed the necessary scripts and services on the workload driver machine as well as on the server under test.

Before running the workload, we iteratively tuned the parameters, such as number of SAP dialog instances, CPU affinity for SAP instances and SQL Server, and number of users per SAP instance, until each

server was running with optimal CPU utilization and response time. We then began the workload runs with a single loop execution of the workload to cache the data from the storage subsystem. We then ran the full test three times and report the median run based on workload operations per hour.

We adjusted the length of the high load period, in number of execution loops, based on the number of users per SAP dialog instance. We ran the test for 10 loops on both systems. The workload driver automatically managed the ramp-up and ramp-down phases, and gathered its SAP ERP statistics during the period of high load. We also collected performance statistics, such as CPU utilization, disk I/O per second, network utilization, and available memory from the Windows Performance Monitor during each run.

## SYSTEM COMPARISON

Figure 1 highlights the key differences between the servers. Appendix A provides detailed configuration information. We tested these configurations and base the costs used in the TCO calculations on these configurations.

Hardware and software specifications	Dell PowerEdge R910 server	HP ProLiant DL385 G7 server
CPU	Intel Xeon X7560	AMD Opteron 6174
CPU speed (GHz)	2.26	2.20
Number of processor packages	2	2
Number of cores per processor package	8	12
Number of hardware threads per core	2	1
Memory type	PC3-8500	PC3-8500/PC3-10600
Total memory	256 GB (32 x 8 GB)	256 GB (8 x 16 GB/16 x 8 GB)
Internal storage	PERC H700 storage controller, 512MB cache 8 x 146GB 6Gb SAS 15,000 RPM 2.5" hot-swappable	P410i storage controller, 512MB cache 2 x 146GB 6Gb SAS 15,000 RPM 2.5" hot-swappable 6 x 72GB 6Gb SAS 15,000 RPM 2.5" hot swappable
Operating system	Windows Server 2008 Enterprise Edition	Windows Server 2008 Enterprise Edition
Database software	Microsoft SQL Server 2008 Enterprise Edition	Microsoft SQL Server 2008 Enterprise Edition

Hardware and software specifications	Dell PowerEdge R910 server	HP ProLiant DL385 G7 server
SAP ERP software	SAP ERP 6.0 central system, and 11 SAP ERP 6.0 dialog instances	SAP ERP 6.0 central system, and 11 SAP ERP 6.0 dialog instances

Figure 1: Key system configuration information for the test servers.

We stored the test databases on external storage and tested both servers using the same external storage array: a Dell EqualLogic™ PS6010XV with 16 x 600GB 6Gb SAS 15,000 RPM 3.5” hot swappable drives connected to a 10Gb Dell PowerConnect™ 8024 switch. Appendix B provides detailed configuration information for the external storage. We omit the costs of the external storage from the TCO analysis, based on the assumption that the external storage is in place or part of a separate procurement.

## WHAT WE FOUND

Figure 2 shows the number of workload operations per hour the test servers achieved during our measurement period of the SAP ERP workload test on the median run. The Dell PowerEdge R910 server, running a dual-socket configuration, achieved a workload-operations-per-hour score of 1,500,339.6 while supporting 4,543 users with a response time of 0.90 seconds.

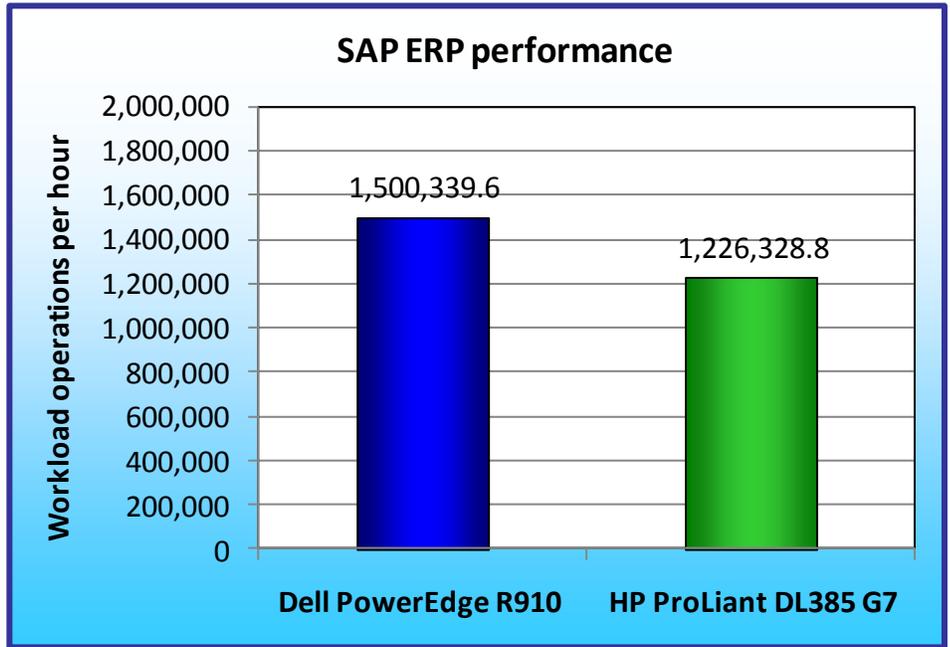


Figure 2: SAP ERP performance results for the two test servers. Higher numbers are better.

This is a 22 percent better SAP ERP performance score than the HP ProLiant DL385 G7 server’s workload-operations-per-hour score of 1,226,328.8, which it attained while supporting 3,691 users with a response time of 0.84 seconds.

We used the ratio of the performance of the two test servers to identify server counts for the two configurations that would deliver comparable performance, using five as the count for the Dell PowerEdge R910 servers. We estimate that six HP ProLiant DL385 G7 servers would deliver comparable performance.

We estimate the score for the multiple-server configuration by multiplying the score of the single server we tested by the number of servers in the configuration. As Figure 3 shows, we estimate that five Dell PowerEdge R910 servers, running a dual-socket configuration, would achieve a workload-operations-per-hour score of 7,501,698.0, 2 percent better than six HP ProLiant DL385 G7 servers, which we estimate would achieve a workload-operations-per-hour score of 7,357,972.8. We calculate TCO for this performance-comparable configuration.

Figure 4 shows our estimate of 3-year TCO for the performance-equivalent configurations. The five Dell PowerEdge R910 servers could deliver 11.0 percent lower TCO in the first year and 13.3 percent lower 3-year TCO than the six HP ProLiant DL385 G7 servers, a savings of \$108,017 over 3 years.

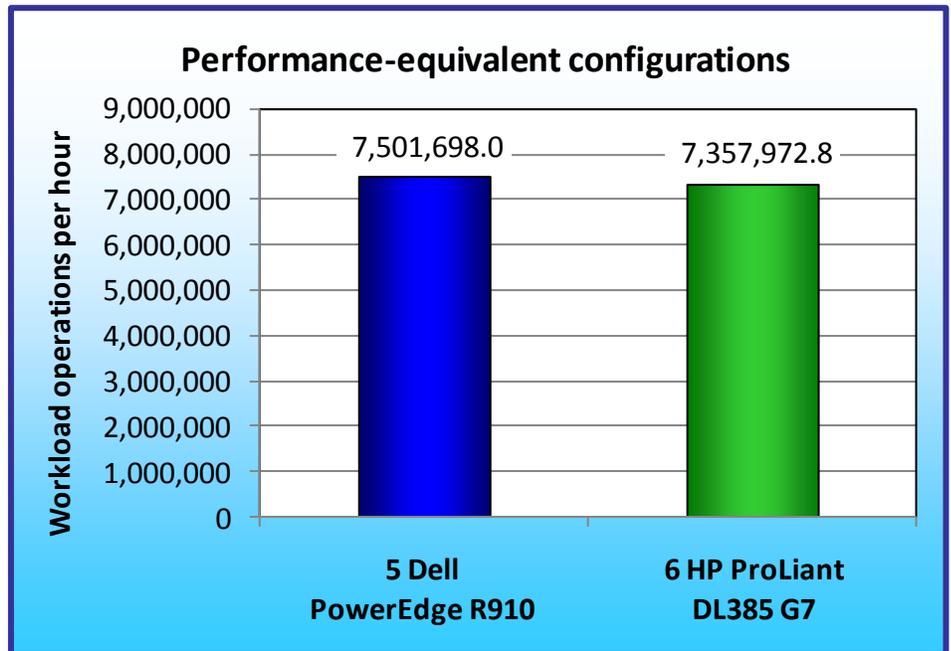


Figure 3: Performance-equivalent configurations based on representative SAP ERP workload. Higher numbers are better.

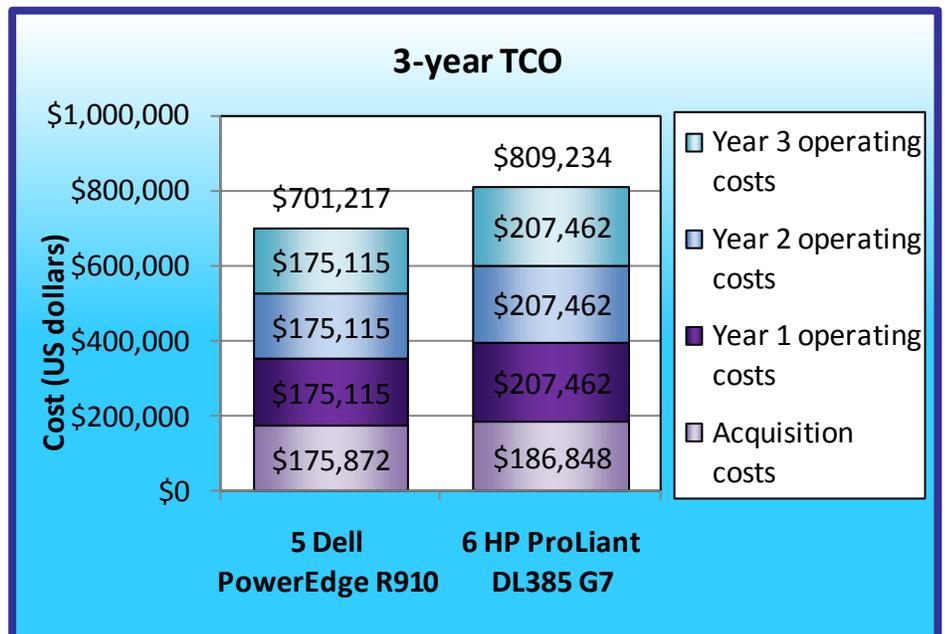


Figure 4: The 3-year TCO for performance-equivalent configurations of the test servers. Lower numbers are better.

In this analysis, the five Dell PowerEdge R910 servers deliver an estimated 3-year TCO advantage because they have lower hardware, provisioning, facilities, software, and management costs than a performance-equivalent configuration of six HP ProLiant DL385 G7 servers.

Appendix C lists the assumptions we made for the TCO analysis.

## HOW WE TESTED

To perform the SAP ERP performance test, we did the following:

- configured the SAP ERP 6.0 system with one central instance and multiple dialog instances
- modified the instance profile parameters to adjust for system hardware, such as number of available cores, buffer sizes, and system RAM amounts
- configured the workload driver system
- installed the workload and iteratively sized the test
- ran the test

The steps involved in creating a formal SAP infrastructure are outside the scope of this report. Such steps would include acquiring the necessary licenses, installing Solution Manager, and configuring an SAP landscape.

At the time we ran our tests, SAP ERP did not support Windows Server 2008 R2.<sup>2</sup> We tested with the latest version it did support: Windows Server 2008 Enterprise Edition with SP2. We also tested with Microsoft SQL Server 2008 instead of the more-recent Microsoft SQL Server 2008 R2 version.

### Setting up the SAP ERP System and workload driver machine

We attached each server to a Dell EqualLogic PS6010XV tray containing 16 hard drives, configured in RAID 10 mode and configured as a single-member storage group. We connected both 10Gb NICs on the Dell EqualLogic PS6010XV storage array to a 10Gb Dell PowerConnect 8024 switch, and we installed a 10Gb NIC in the server for iSCSI network traffic and attached the server to the Dell PowerConnect 8024 switch. We created a 650GB volume for SQL Server data storage and, by implication, the SAP SQL Server database files, for each server and exposed this volume via the Microsoft iSCSI Initiator.

For internal storage, we used the respective RAID configuration utilities on each system to create a two-disk RAID 1 for the operating system, SQL Server software, and SAP software. We then configured a six-disk RAID 10 that contained SQL Server transaction log files and the TEMPDB transaction log files.

---

<sup>2</sup> Source: <http://www.sdn.sap.com/irj/sdn/windows?rid=/webcontent/uuid/901004e6-15ce-2c10-afa4-ec948139a17c#section3>

Following the operating system installation, we installed all recommended Windows® updates. We then installed SQL Server 2008, SQL Server 2008 Service Pack 1, the SAP ERP Central Instance, multiple SAP ERP dialog instances, and necessary software for the workload.

### Configuring the storage for the server

1. Connect the external storage to the Dell PowerConnect 8024 switch.
2. Connect a workstation via serial connection to the Dell EqualLogic PS6010XV, and configure the storage group.
3. Create the volumes on the external storage necessary for SQL Server database files.
4. Install a 10Gb NIC in the server, and connect the NIC to the Dell PowerConnect 8024 switch.
5. On the server, create a two-disk RAID 1 for the operating system, SQL Server software, and SAP software, and a six-disk RAID 10 to contain the SQL Server transaction log files.

### Configuring the server and database software

1. Adjust BIOS settings as needed. For our study, we turned off prefetchers and set the power management to maximum performance on each system.
2. Install Windows Server 2008, Enterprise x64 Edition with SP2.
3. Install all recommended Windows updates, and reboot the server when it prompts you.
4. Disable the Windows firewall, enable the Lock Pages in Memory option, and assign a static IP address to all network interfaces.
5. Add an entry to the C:\Windows\System32\drivers\etc\hosts file to have an entry for all systems involved. An example might be:  

```
192.168.1.201 machinename.mynet.local
```

In this example, 192.168.1.201 is the IP address and machinename is the hostname of the system under test.
6. Turn off the User Account Control (UAC) in Windows Server 2008 by following the instructions at [http://technet.microsoft.com/en-us/library/cc709691\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/cc709691(WS.10).aspx).
7. Install SQL Server 2008 according to the instructions in section 4.2.4 of *Installation Guide SAP ERP 6.0 - EHP4 Ready SR1 ABAP on Windows: MS SQL Server*, available from the SAP Service Marketplace. Set SQL Server options as follows:
  - a. Set SQL affinity to restrict it to certain sockets on each configuration. This will vary by system.
  - b. Set SQL I/O affinity to restrict it to certain sockets on each configuration. This will vary by system.
  - c. Set SQL Server minimum and maximum memory settings on each configuration based on system RAM available and SAP needs. This will vary by system.
  - d. Set the SQL Server network packet size to 8192.
  - e. Set the SQL Server priority boost option.
  - f. To remove any potential storage bottleneck, set the Recovery Interval to 32768.
8. Modify SQL Agent properties as specified in *Installation Guide SAP ERP 6.0 - EHP4 Ready SR1 ABAP on Windows: MS SQL Server*.

## Installing SAP ERP 6.0

Note – for this section, we followed the guidelines set forth in *Installation Guide SAP ERP 6.0 - EHP4 Ready SR1 ABAP on Windows: MS SQL Server*, available from the SAP Service Marketplace. Please see that guide for step-by-step installation details. Here, we provide our high-level methodology.

1. Prepare a shared folder for the SAP Transport host.
2. Install Java™ 1.4.2 JDK, as required by SAP engine (available from [http://www.sun.com/software/javaforbusiness/sap\\_download.jsp](http://www.sun.com/software/javaforbusiness/sap_download.jsp)).
3. Copy the relevant installation media to the local hard drive of each server for ease of installation. For our installation, we used the following:
  - SAP Installation Master SR1, found on DVD 51036888 titled *Installation Master SR1*
  - Kernel 7.01, found on DVD 51036767 titled *SAP EHP1 FOR SAP NETWEAVER® 7.0 SR1*
  - Installation Export, found on DVD 51036902, titled *SAP ERP 6.0 EHP4 READY*
4. Start SAPinst, and choose to install SAP ERP 6.0 Central System on the Microsoft SQL Server platform.
5. Step through the SAP ERP installation, and provide relevant details for your machine, such as SAPSID, user credentials, file locations, and so on.
6. Finalize the installation parameters, enter the license key from Solution Manager, and continue. The ERP install of the Central System will take approximately 2 to 4 hours.
7. After the SAP ERP installation completes, start the SAP services by using the Microsoft Management Console (MMC) application.
8. Download Java JRE 1.5 release 22 32-bit from [www.java.com/en/download/manual.jsp](http://www.java.com/en/download/manual.jsp). Install the JRE with default options, and modify the system environment path to use the bin directory of this JRE installation.
9. Install the SAP GUI using the PlatinGUI utility.
10. Modify the Central System profile parameters as required.
11. Install additional dialog instances as necessary.
12. Modify the additional dialog instances' profile parameters as required.

## Preparing the system for the workload

1. Download ActivePerl-5.10.1.1007-MSWin32-x64-291969.msi from <http://downloads.activestate.com/ActivePerl/releases/5.10.1.1007/> and install Perl.
2. Create user accounts as needed.
3. Copy workload tools and scripts to the local machine.
4. Set up an FTP server by following the instructions at [http://technet.microsoft.com/en-us/library/dd722761\(W.S.10\).aspx](http://technet.microsoft.com/en-us/library/dd722761(W.S.10).aspx).
5. Configure the FTP home directory for file transfer.
6. Set up the SAPOSCOL service and service account on the server under test.
7. Install the workload scripts, directories, and services as required.
8. Update the SAP system to add necessary clients and set buffer parameters as necessary.
9. As recommended in *Note 1357244 - High Performance 7.01 Kernel for Windows*, we used the high-performance SAP Kernel. Stop all services, archive the original installation files, and copy the high-performance files to the appropriate exe directories. While this kernel does yield better performance, SAP does not recommend it for all situations.

## Configuring the driver system

1. Create a RAID volume for the operating system and workload utilities.
2. Install Windows Server 2008 Enterprise Edition with SP2.
3. Install all recommended Windows updates, rebooting the machine as necessary.
4. Disable the Windows firewall, and assign static IP address to all network interfaces.
5. Download ActivePerl-5.10.1.1007-MSWin32-x64-291969.msi from <http://downloads.activestate.com/ActivePerl/releases/5.10.1.1007/> and install Perl.
6. Create user accounts as needed, and install the workload scripts.
7. Configure connection and access to the ERP system.

## HOW WE CALCULATED TCO

We obtained the hardware costs and 3-year hardware support costs from the Dell and HP Web sites on August 16, 2010. The Dell PowerEdge R910 cost includes hardware and 3-year ProSupport for IT 4HR 7x24 Onsite: Non-Mission Critical for one server multiplied by the five servers in the configuration. The price for the HP ProLiant DL385 G7s includes hardware and HP Care Pack, 3 Years, 4-hour 24x7 for one server multiplied by the six servers in the configuration. The five Dell PowerEdge R910 servers cost 5.5 percent less than six HP ProLiant DL385 G7 servers.<sup>3</sup> We use list price for all prices in this analysis.

We based energy cost calculations for the TCO analysis on power estimates provided by power usage calculators on the vendor sites for the two server models on September 9, 2010. We used 300GB drives for the power estimates because the Dell power calculator did not include the 146GB drives we used in our tests. We selected estimates for 50 percent utilization, and on the Dell calculator a transactional workload. We matched the test machines as closely as we could. The HP Power Analyzer estimated 456.7 watts for an HP ProLiant DL385 G7 with dual AMD Opteron processor Model 6174, 256 GB (8 x 16 GB/16 x 8 GB) memory, eight 300GB SAS 10K hard drives, an HP PCIe Gigabit server adapter, a 10 GbE PCI-e G2 Dual Port NIC, and two 1,200W power supply kits.<sup>4</sup> The Dell Energy Smart Solution Advisor estimated 688.7 watts for a Dell PowerEdge R910 server configured with dual Intel Xeon Processor X7560s, 256 GB (32 x 8GB) memory, eight 300GB SAS 10K hard drives, an Intel 10GBe single-port NIC, dual two-port embedded Broadcom® NetXtreme® II 5709 Gigabit Ethernet Controllers, and redundant (2+2) high output power supplies.<sup>5</sup>

## TCO results

Figure 5 details the results of our TCO analysis of the two server configurations. The five Dell PowerEdge R910 servers provide 13.3 percent lower 3-year TCO compared to the six HP ProLiant DL385 G7

---

<sup>3</sup> Source: Principled Technologies, Inc., SAP ERP Performance and TCO: Dell PowerEdge R910 vs. HP ProLiant DL385 G7, a September 2010 report commissioned by Dell Inc.

<sup>4</sup> Source: <http://h18000.www1.hp.com/products/solutions/power/advisor-online/HPPowerAdvisor.html>

<sup>5</sup> Source: <http://solutions.dell.com/DellStarOnline/DCCP.aspx?c=us&l=en&s=biz&Template=6945c07e-3be7-47aa-b318-18f9052df893>

servers.<sup>6</sup> Acquisition costs, which include hardware, hardware support, and provisioning, for the five Dell PowerEdge R910 servers are 5.9 percent lower and 3-year operating costs are 15.6 percent lower than for the six HP ProLiant DL385 G7 servers.<sup>7</sup>

Costs	5 Dell PowerEdge R910 servers	6 HP ProLiant DL385 G7 servers
Acquisition costs (hardware, hardware support, and provisioning)	\$175,872	\$186,848
3-year operating costs (energy, data center, software and software support, and server administration)	\$525,345	\$622,386
<b>Total</b>	<b>\$701,217</b>	<b>\$809,234</b>

Figure 5: TCO for the five Dell PowerEdge R910 servers and the six HP ProLiant DL385 G7 servers. Lower costs are better.

### Acquisition costs

Acquisition costs include server purchase, 3-year hardware support, and provisioning.

- **Server hardware and 3-year support.** We researched purchase prices for the hardware and support on the Dell and HP Web sites. We include list prices without discounts for both solutions. The five Dell PowerEdge R910 servers cost \$169,205 for hardware, including 3-year ProSupport 4HR 7x24 Onsite Non-Mission Critical, compared to \$179,070 for the six HP ProLiant DL385 G7 servers with HP Care Pack, 3 Years, 4-hour 24x7.
- **Provisioning.** We used our own estimates for planning time, and relied on our own lab experience of setting up and installing software on these servers. We estimate that each configuration requires 40 hours planning and setup time for the first server and 20 hours for the each additional server. We estimate a provisioning cost of \$2,223 for the first server in each configuration and half that cost for each subsequent server, for a total provisioning cost of \$6,667 for the Dell PowerEdge R910 servers and \$7,778 for the HP ProLiant DL385 G7 servers.

Figure 6 presents the acquisition costs we considered in this analysis.

Acquisition costs	5 Dell PowerEdge R910 servers	6 HP ProLiant DL385 G7 servers
Hardware cost (hardware purchase and 3-year hardware support)	\$169,205	\$179,070
Provisioning cost (administrator time to acquire and set up server)	\$6,667	\$7,778
<b>Total</b>	<b>\$175,872</b>	<b>\$186,848</b>

Figure 6: Acquisition costs for the two server configurations. Lower costs are better. Higher savings are better.

<sup>6</sup> Source: Principled Technologies, Inc., Principled Technologies, Inc., SAP ERP Performance and TCO: Dell PowerEdge R910 vs. HP ProLiant DL385 G7, a September 2010 report commissioned by Dell Inc.

<sup>7</sup> *Ibid.*

## Operating costs

Operating costs include operating system, database software, Microsoft Software Assurance agreements, prorated rack space and port costs, energy for powering and cooling the servers, and labor for the server administrator. Figure 7 shows our estimates of the operating costs for the two solutions over 3 years.

Operating costs	5 Dell PowerEdge R910 servers	6 HP ProLiant DL385 G7 servers
Software costs (Microsoft Windows Server 2008 and Microsoft Windows SQL Server 2008)	\$154,590	\$185,508
Facilities costs (rack space and port costs)	\$2,055	\$2,202
Energy costs (power and cooling)	\$5,970	\$4,752
Management costs (labor for server administration)	\$12,500	\$15,000
<b>Total</b>	<b>\$175,115</b>	<b>\$207,462</b>

**Figure 7: Three-year operating costs for the two server configurations. Lower costs are better. Higher savings are better.**

### Software and software support costs

In this analysis, we include costs for Windows Server 2008 Enterprise Edition licensed per server and Microsoft SQL Server 2008 Enterprise Edition licensed per processor. We spread the license costs equally over the 3 years included in this analysis and include annual costs for Microsoft Software Assurance agreements. The servers in this analysis have the same processor count so each server has the same software costs. We multiply these software costs by the number of servers in each configuration. We estimate the annual cost for these two software packages for the five Dell PowerEdge R910 servers at \$154,590 and for the six HP ProLiant DL385 G7 servers at \$185,508, a 16.7 percent savings for the Dell PowerEdge R910 configuration.

We do not include costs for the SAP ERP software. SAP requires package licenses and named user licenses for SAP ERP software. SAP bases prices for package licenses on business metrics such as the number of orders processed, number of contracts tracked, gross written premiums, or patients treated. SAP bases named user license prices on the number of users who will access the license functionality.<sup>8</sup> We omit SAP costs from this hardware cost analysis because costs for both of these licenses are calculated based on workloads and would not be affected by the choice of hardware to run the workloads.

---

<sup>8</sup> Source: <http://www12.sap.com/solutions/licensingmodel/index.epx> and the "Licensing SAP Products, a Guide for Buyers" PDF available for download on that page.

## Facilities costs

We estimate two sources of facility costs: rack costs based on number of rack units in the solution and port costs based on the number of servers in the configuration. Rack costs would be higher and port costs would be lower for the five 4u Dell PowerEdge R910 servers compared to the six 2u HP ProLiant DL385 G7 servers. Based on our estimate of \$22 per rack unit for rack costs and \$323 per server for port costs each year, the Dell PowerEdge R910 servers have 6.7 percent lower facility costs than the HP ProLiant DL385 G7 servers.

## Energy costs

The five Dell PowerEdge R910 servers use more power than the six HP ProLiant DL385 G7 servers based on estimates using power usage calculators on the vendors' sites.

## Management costs

We estimate labor costs for server administration at a fixed cost of \$2,500 per server and multiply that by the number of servers in each configuration. The five Dell PowerEdge R910 servers deliver a 16.7 percent savings in management costs over the six HP ProLiant DL385 G7 servers.

## SUMMARY

We calculated the TCO for a hypothetical large-scale enterprise that plans to purchase performance-comparable configurations of either Dell PowerEdge R910 servers or HP ProLiant DL385 G7 servers for an SAP ERP environment running under Windows Server 2008 and SQL Server 2008. We used each server's performance running an SAP ERP workload to determine the number of servers in the performance-equivalent configurations and then calculated the cost of the two solutions.

In hands-on tests in our labs, the Dell PowerEdge R910 server, running in a dual-socket configuration, delivered 22 percent better SAP performance, and supported more than 20 percent more users than the HP ProLiant DL385 G7 dual-socket server.

We defined the following performance-equivalent configurations based on those SAP performance results:

- Five Intel Xeon Processor X7560-powered Dell PowerEdge R910 servers running in a dual-socket configuration
- Six AMD Opteron processor Model 6174-powered HP ProLiant DL385 G7 servers

We calculated costs for those configurations. The Dell PowerEdge R910 configuration had a lower acquisition cost and lower annual costs than the performance-equivalent HP ProLiant DL385 G7 configuration. The savings were due to the following key factors:

- The Dell PowerEdge R910 configuration costs 5.5 percent less for hardware and hardware support.
- The Dell PowerEdge R910 configuration cost 16.7 percent less for software licensed on a per-server basis or per-processor basis.
- The Dell PowerEdge R910 configuration saves 6.7 percent in facility costs.
- The Dell PowerEdge R910 requires 16.7 percent less management time, which we allocate on a per-server basis.

We calculate that five Dell PowerEdge R910 servers save \$10,976 in acquisition costs and \$97,041 in operating costs over 3 years compared to the cost of the performance-equivalent configuration of six HP ProLiant DL385 G7 servers. Because of these savings, in this analysis, the Dell PowerEdge R910 configuration delivers 10.9 percent lower TCO in the first year and 13.3 percent lower 3-year TCO.

## APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 8 provides detailed configuration information about the two test servers.

System	Dell PowerEdge R910	HP ProLiant DL385 G7
<b>Power supplies</b>		
Total number	4	2
Vendor and model number	Dell L1100A-S0	HP 490594-001
Wattage of each (W)	1,100	1,200
<b>Cooling fans</b>		
Total number	6	6
Vendor and model number	Delta Electronics PFC1212DE	Nidec Ultraflo V60E12BS1A7-09A032
Dimensions (h x w) of each (inches)	5-1/4 x 1-3/4	2 x 2-1/2
Volts	12	12
Amps	4.80	2.45
<b>General</b>		
Number of processor packages	2	2
Number of cores per processor	8	12
Number of hardware threads per core	2	1
System power management policy	Windows Balanced Power Policy	Windows Balanced Power Policy
<b>CPU</b>		
Vendor	Intel	AMD
Name	Xeon	Opteron
Model number	X7560	6174
Stepping	D0	D1
Socket type	LGA 1567	Socket G34
Core frequency (GHz)	2.26	2.20
Bus frequency	6.4 GT/s	6.4 GT/s
L1 cache (KB)	32 + 32 (per core)	64 + 64 (per core)
L2 cache (KB)	256 (per core)	512 (per core)
L3 cache (MB)	24	12
<b>Platform</b>		
Vendor and model number	Dell PowerEdge R910	HP ProLiant DL385 G7
Motherboard model number	OP658H	538981-001
Motherboard chipset	Intel ID3407	AMD SR5690
BIOS name and version	Dell Inc 1.1.7 (5/25/2010)	HP A18 (04/12/2010)

System	Dell PowerEdge R910	HP ProLiant DL385 G7
BIOS settings	Power Management: Maximum Performance Hardware Prefetcher: Disabled Adjacent Cache Line Prefetcher: Disabled	Power Profile: Max performance selected
<b>Memory module(s)</b>		
Total RAM in system (GB)	256	256
Number of memory module types	1	2
<b>First type of module in system</b>		
Vendor and model number	Samsung M393B1G0DJ1-CF8	Hynix HMT42GR7AMRC-G7
Type	DDR3 PC3-8500	DDR3 PC3-8500
Speed (MHz)	1,067	1,067
Speed running in the system (MHz)	1,067	800
Size (GB)	8	16
Number of RAM module(s)	32	8
Chip organization	Double-sided	Double-sided
Rank	Quad	Quad
<b>Second type of module in system</b>		
Vendor and model number	N/A	Samsung M393B1K70BH1-CH9
Type	N/A	DDR3 PC3-10600
Speed (MHz)	N/A	1,333
Speed running in the system (MHz)	N/A	800
Size (GB)	N/A	8
Number of RAM module(s)	N/A	16
Chip organization	N/A	Double-sided
Rank	N/A	Dual
<b>Hard disk 1</b>		
Vendor and model number	Dell ST9146852SS	HP EH0146FARWD
Number of disks in system	8	2
Size (GB)	146	146
Buffer size (MB)	16	16
RPM	15,000	15,000
Type	SAS	SAS
<b>Hard disk 2</b>		
Vendor and model number	N/A	HP DH0072FAQRD
Number of disks in system	N/A	6
Size (GB)	N/A	72
Buffer size (MB)	N/A	16
RPM	N/A	15,000
Type	N/A	SAS

<b>System</b>	<b>Dell PowerEdge R910</b>	<b>HP ProLiant DL385 G7</b>
<b>Disk controller</b>		
Vendor and model	Dell PERC H700	HP Smart Array P410i
Controller cache (MB)	512	512
Controller driver	DELL 4.17.2.64 (9/28/2009)	Hewlett-Packard Company 6.20.0.64 (2/22/2010)
Controller firmware	12.0.1-0091	3.0
RAID configuration	2 disks: RAID 1 6 disks: RAID 10	2 disks: RAID 1 6 disks: RAID 10
<b>Operating system</b>		
Name	Windows Server 2008 Enterprise Edition	Windows Server 2008 Enterprise Edition
Build number	6002	6002
Service pack	Service Pack 2	Service Pack 2
File system	NTFS	NTFS
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English
<b>Graphics</b>		
Vendor and model number	Matrox® G200eW	ATI ES1000
Graphics memory (MB)	8	32
Driver	Microsoft 6.0.6001.18000 (6/20/2006)	Microsoft 6.0.6001.18000 (6/21/2006)
<b>Ethernet 1</b>		
Vendor and model number	Broadcom BCM5709C NetXtreme II GigE	HP NC382i DP Multifunction Gigabit Server Adapter
Type	Integrated	Integrated
Driver	Broadcom 5.2.14.0 (12/17/2009)	Hewlett-Packard Company 5.2.14.0 (12/17/2009)
<b>Ethernet 2</b>		
Vendor and model number	Intel 10 Gigabit AT Server Adapter (EXPX9501AT)	Intel 10 Gigabit AT Server Adapter (EXPX9501AT)
Type	PCI-Express	PCI-Express
Driver	Intel 2.4.28.0 (4/20/2010)	Intel 2.4.28.0 (4/20/2010)
<b>Optical drive(s)</b>		
Vendor and model number	TEAC DV-28S-W ATA Device	DV-28S HP 461644-932
Type	DVD-ROM	DVD-ROM
<b>USB ports</b>		
Number	4	4
Type	2.0	2.0

**Figure 8: Configuration information for the test servers.**

## APPENDIX B - TEST STORAGE INFORMATION

Figure 9 provides detailed configuration information about the storage array system.

Storage array	Dell EqualLogic SAN
Arrays	One Dell EqualLogic PS6010XV array
Disks	16 x 15,000RPM SAS disks
Active storage cache (GB)	4
Firmware revision	v4.3.5 Patch L1
Switch type/model	One Dell PowerConnect 8024
Disk vendor and model number	Seagate ST3600057SS
Disk size (GB)	600
Disk buffer size (MB)	16

**Figure 9: Detailed configuration information for the storage array system.**

## APPENDIX C – ASSUMPTIONS

We used an SAP ERP workload to identify performance-equivalent configurations of the two servers and then calculated TCO for those configurations.

We made the following assumptions in creating the TCO estimates in this report.

### General assumptions

- Simplifying assumptions include assuming all prices for ongoing costs such as power, data center space, data center ports, and administrator salaries stay the same for the 3-year timeframe of the analysis.
- We include list prices with no discounts for all prices. We used list prices for all purchase costs because discounts vary by buyer and by vendor; this approach provides the most level playing field possible for our comparison. Costs do not include taxes or shipping costs.
- We do not include the costs of the external storage arrays or the cables and switches used to connect the servers to the storage in this analysis. In our tests, the two servers used the same storage arrays. We assume the hypothetical enterprise in this analysis either has the storage arrays in house already or is acquiring them in a separate procurement.

### Acquisition costs

- We assume the current server administrator has experience in both Microsoft Windows Server 2008 and Microsoft SQL Server 2008 and does not require additional training on these software packages. We therefore do not include administrator training in the costs.
- We also assume that staff have experience with SAP ERP and do not require additional training for that software.
- We assume that the administrator or other similarly compensated staff requires 40 hours for planning, procurement, and setting up the first server of either solution and half that time for each additional server. We include costs for that time in our provisioning cost estimate.
- We assume that the target enterprise prefers 3-year support including 7x24 on-site support with 4-hour response time. Our support prices for the Dell PowerEdge R910 include non-mission critical support available 24 hours a day/7 days a week with a 4-hour response time. Dell offers a higher-cost mission-critical support that provides additional coverage. The Dell non-mission critical support is a closer match to the support with 24-hour-a-day, 7-day-a-week service with a 4-hour response time that is available from HP. Under these agreements, the vendor, not the data center staff, does the majority of hardware maintenance. We did not include any additional maintenance costs.

### Software costs

- We include costs for the OS version we used in testing, Microsoft Windows Server 2008 Enterprise Edition. We include costs for a license plus annual Microsoft Software Assurance costs for each server, licensed on a per server basis. We use Enterprise licenses rather than Standard license because the servers exceed the memory limit of the Standard license.
- We include costs for the database software version we used in testing, Microsoft SQL Server 2008 Enterprise Edition. We include costs for a license plus annual Microsoft Software Assurance costs for each server licensed on a per-processor basis. The enterprise chooses per-processor licensing because with those licenses they can avoid the cost client access licenses, which the per-processor licenses do not require but the less expensive per-server licenses do.

- We do not include costs for the SAP ERP software. SAP requires package licenses and named user licenses for SAP ERP software. We omit these costs from this hardware cost analysis because SAP calculates costs for both of these licenses based on workloads with the result that the choice of hardware to run the workloads choices would not affect these costs.

#### Facilities costs

- Facilities costs include rack costs that reflect rack footprint, including clearances and port costs.
- We assume that the data center fills racks to capacity and has adequate power and cooling capacity for those full racks.
- We assume that data center Ethernet port costs average \$323 per port per year for the switch hardware and hardware support. We base costs on a 24-port Dell PowerConnect 8024 10Gb Ethernet switch.
- We assume that the data center charges \$910 per rack per year for data center space. We based this on a cost of \$65 per square foot per year for data center space and an average of 14 square feet per rack, including both the space the rack occupies and the necessary clearances around it.

#### Energy costs

- We assume that the hardware is busy one-half of the time and idle the remaining time, and it runs all day, every day. We used power analyzers on the vendor websites to estimate power usage for the servers at 50 percent utilization.
- We assume that for each dollar the business spends on electricity for server power, it spends an additional dollar on power to cool the server and to power auxiliary equipment.<sup>9</sup> Data centers may have different proportions of these costs because cooling efficiency and technology, rack densities, and other factors affect cooling costs.
- We assume that the data center costs for power and cooling are \$0.0993 per kWh.<sup>10</sup> We base this estimate on the Department of Energy's data on average commercial charges for the year ending August 2010.

#### Management costs

- We assume the average annual loaded server administrator cost is \$100,000.
- We assume that each system administrator supports 40 servers of either solution.
- We include server administrators but not database or SAP administrators. The number of database and SAP administrators would be the same for the two solutions, because the two solutions would support the same database workload.
- We do not include costs for management software.

---

<sup>9</sup>Estimating Total Power Consumption by Servers in the U.S. and the World, Jonathan G. Koomey, PhD, February 15, 2007  
<http://enterprise.amd.com/Downloads/svrpwrusecompletefinal.pdf>

<sup>10</sup> Source: National commercial average for April 2010 as reported in [http://www.eia.doe.gov/cneaf/electricity/epm/table5\\_6\\_a.html](http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html)

## ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.  
1007 Slater Road, Suite 300  
Durham, NC, 27703  
[www.principledtechnologies.com](http://www.principledtechnologies.com)

We provide industry-leading fact-based marketing and technology assessment services that help technology vendors and buyers understand the real differences among products. We bring to every assignment extensive experience with and expertise in all aspects of technology marketing, testing, and analysis; from researching new technologies, to developing new methodologies, to testing with existing and new tools, to delivering the results in whatever form best communicates them.

When the assessment is complete, we know how to present the results to a broad range of target audiences. We provide our clients with the materials they need, from market-focused data to use in their own collateral to custom sales aids, such as test reports, performance assessments, white papers, PowerPoint presentations, and videos. Every piece of collateral reflects the results of our trusted independent analysis.

We customize our services to focus on each client's requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to assess how it will fare against its competition and to highlight its strengths.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for 25 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.

---

Principled Technologies is a registered trademark of Principled Technologies, Inc.  
All other product names are the trademarks of their respective owners.

---

Disclaimer of Warranties; Limitation of Liability:

PRINCIPLED TECHNOLOGIES, INC. HAS MADE REASONABLE EFFORTS TO ENSURE THE ACCURACY AND VALIDITY OF ITS TESTING, HOWEVER, PRINCIPLED TECHNOLOGIES, INC. SPECIFICALLY DISCLAIMS ANY WARRANTY, EXPRESSED OR IMPLIED, RELATING TO THE TEST RESULTS AND ANALYSIS, THEIR ACCURACY, COMPLETENESS OR QUALITY, INCLUDING ANY IMPLIED WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE. ALL PERSONS OR ENTITIES RELYING ON THE RESULTS OF ANY TESTING DO SO AT THEIR OWN RISK, AND AGREE THAT PRINCIPLED TECHNOLOGIES, INC., ITS EMPLOYEES AND ITS SUBCONTRACTORS SHALL HAVE NO LIABILITY WHATSOEVER FROM ANY CLAIM OF LOSS OR DAMAGE ON ACCOUNT OF ANY ALLEGED ERROR OR DEFECT IN ANY TESTING PROCEDURE OR RESULT.

IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC. BE LIABLE FOR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN CONNECTION WITH ITS TESTING, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. IN NO EVENT SHALL PRINCIPLED TECHNOLOGIES, INC.'S LIABILITY, INCLUDING FOR DIRECT DAMAGES, EXCEED THE AMOUNTS PAID IN CONNECTION WITH PRINCIPLED TECHNOLOGIES, INC.'S TESTING. CUSTOMER'S SOLE AND EXCLUSIVE REMEDIES ARE AS SET FORTH HEREIN.

---