

Total cost of ownership (TCO) of Dell, HP, and IBM blade solutions

TCO comparison

Dell Inc. (Dell) commissioned Principled Technologies (PT) to compare the total cost of ownership (TCO) of three blade solutions, which we list in alphabetical order:

- Dell PowerEdge M1000e
- HP BladeSystem c-Class
- IBM BladeCenter H Type 8852

KEY FINDING

In all comparisons, the Dell PowerEdge M1000e blade solution had the lowest TCO and yielded significant savings over the HP and IBM solutions.¹

TCO includes hardware, support, management software, IO virtualization, power, cooling, network ports, and data center space. We examined the TCO of these blade solutions at acquisition and at 1, 3, and 5 years. We compared costs by rack, by chassis, and by blade. We also factored into our analysis the results of our earlier performance tests of these solutions.

Dell TCO savings per rack, chassis, and blade

Figures 1 through 3 estimate acquisition costs and 1-, 3-, and 5-year TCO for similar configurations of each solution. Each blade includes two 2.33-GHz Quad-core Intel Xeon processors, two 73-GB 10,000 RPM disk drives, and 4GB of RAM. We configured each enclosure with two Gigabit Ethernet pass-through modules.

	Savings per rack			
	Dell over HP		Dell over IBM	
Acquisition costs	\$91,681	21.5%	\$35,885	9.7%
TCO for 1 year	\$95,649	20.0%	\$38,959	9.2%
TCO for 3 years	\$103,585	17.8%	\$45,107	8.6%
TCO for 5 years	\$110,002	15.0%	\$48,935	7.3%

Figure 1: Dell offers significant savings per rack² over HP and IBM in acquisition costs and 1-, 3-, and 5-year TCO.

	Savings per chassis			
	Dell over HP		Dell over IBM	
Acquisition costs	\$22,920	21.5%	\$8,971	9.7%
TCO for 1 year	\$23,912	20.0%	\$9,740	9.2%
TCO for 3 years	\$25,896	17.8%	\$11,277	8.6%
TCO for 5 years	\$27,501	15.0%	\$12,234	7.3%

Figure 2: Dell offers significant savings per chassis over HP and IBM in acquisition costs and 1-, 3-, and 5-year TCO.

¹ Based on Principled Technologies report "Total cost of ownership (TCO) of Dell, HP, and IBM blade solutions" commissioned by Dell in September 2008. TCO includes hardware, support, management software, IO virtualization, power, cooling, network ports, and data center space.

² The Dell PowerEdge M1000e and HP BladeSystem c-Class solutions each support 16 blades per enclosure, or 64 blades per 42u rack. The IBM BladeCenter H Type 8852 supports 14 blades per enclosure, or 56 per 42u rack. To provide a fair comparison, we estimated costs for 64 blades for all three solutions, which required us to add a second IBM rack with eight additional IBM blades to make its blade count the same as that of the other solutions.

	Savings per blade			
	Dell over HP		Dell over IBM	
Acquisition costs	\$1,433	21.5%	\$561	9.7%
TCO for 1 year	\$1,495	20.0%	\$609	9.2%
TCO for 3 years	\$1,619	17.8%	\$705	8.6%
TCO for 5 years	\$1,719	15.0%	\$765	7.3%

Figure 3: Dell offers significant savings per blade over HP and IBM in acquisition costs and 1-, 3-, and 5-year TCO.

We provide the details that support this analysis in Appendix A.

The TCO analysis we present in Figures 1 through 3 draws on power consumption and out-of-box setup findings for the Dell, HP, and IBM blade solutions from two previous PT studies.³ For those studies, we configured and tested a full enclosure or chassis for each of the three blade solutions. In those studies we found:

NOTE

Dell's lower costs for management software and I/O virtualization software contribute significantly to Dell's cost savings.⁴

- The Dell PowerEdge M series blades used 9 percent less power per blade than did the HP and the IBM blades.
- The Dell solution sets up in minutes. Setting up the HP and IBM solutions requires an enterprise to either devote approximately 2 to 3 hours per rack or to incur additional charges for factory or channel partner build services.

Another perspective on TCO: Performance equivalents

An enterprise seeking a solution that will deliver a desired level of performance may size its blade solutions to meet that goal. This sizing process can result in solutions that vary greatly in size, complexity, and cost. Because the solution with the highest-performing blades requires the fewest blades, enclosures, and racks, it also costs the least for space, power, and cooling, and it thus requires fewer management software licenses and support agreements.

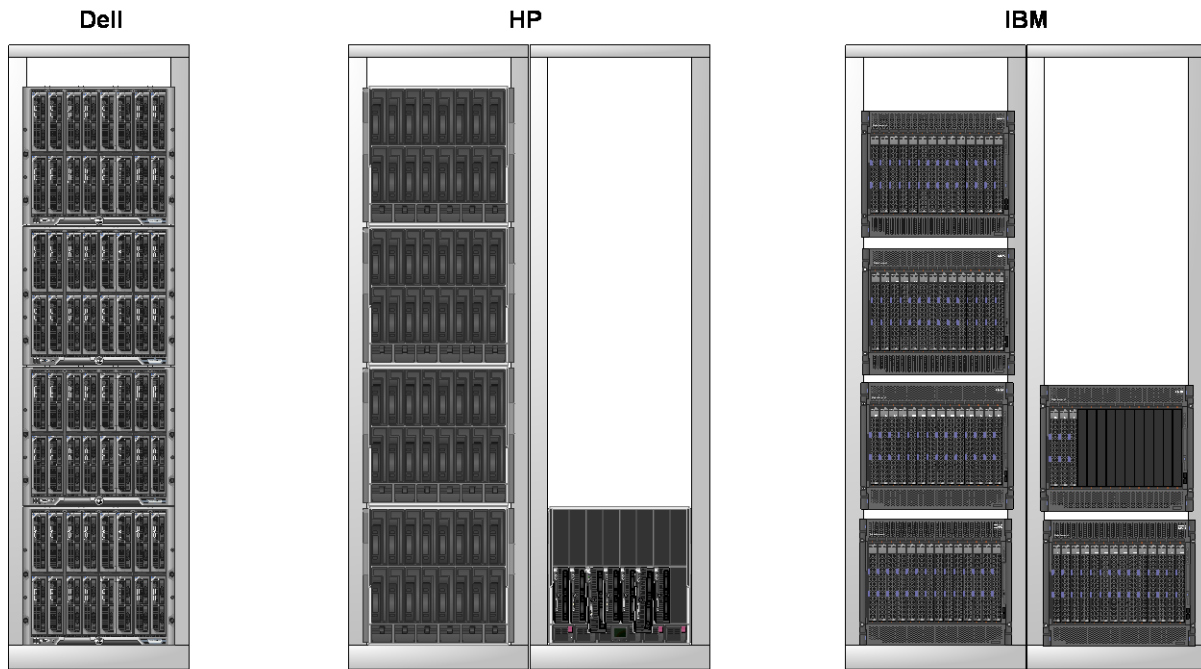
This section examines TCO from the perspective of configurations that deliver comparable performance. For this comparison, we used our SPECjbb2005 results from one of the studies we cited earlier to estimate the size of the HP and IBM solutions that would deliver performance equal to a single rack of the Dell solution.

At peak load, each blade in the Dell PowerEdge solution delivered 9.5 percent greater performance than the HP solution and 13.9 percent greater performance than the IBM solution. This difference in SPECjbb2005 scores translates into a significant difference in the number of individual blades a company needs to achieve comparable performance. The difference thus also accounts for major differences in overall configuration size and cost.

Each configuration includes one rack filled to maximum blade capacity, i.e., four 10u enclosures, each holding 16 blades, for the Dell and HP solutions, and four 9u enclosures, each holding 14 blades, for the IBM solution. For the HP and IBM solutions we also added the additional blades they needed to be able to match the performance of the single Dell rack. We rounded our results up to the nearest blade. Figure 4 shows the resulting performance-equivalent configurations.

³ Windows Server 2008 SPECjbb2005 performance and power consumption on Dell, HP, and IBM blade servers (http://www.principledtechnologies.com/Clients/Reports/Dell/Win2K8_blades0208.pdf) and Out-of-Box Comparison between Dell, HP, and IBM servers (<http://www.principledtechnologies.com/Clients/Reports/Dell/DellHPIBMbladeserverOOB1207.pdf>)

⁴ Based on Principled Technologies report "Total cost of ownership (TCO) of Dell, HP, and IBM blade solutions" commissioned by Dell in September 2008. TCO includes hardware, support, management software, IO virtualization, power, cooling, network ports, and data center space.



64 Dell blades in one rack of 4 enclosures with a maximum of 16 blades each

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71 HP blades in 2 racks with 5 enclosures with a maximum of 16 blades each

=

73 IBM blades in 2 racks with 6 enclosures with a maximum of 14 blades each

Figure 4. Estimated size of solutions needed to deliver the performance equivalent of one rack of the Dell solution. We base estimates on ratios of the results of our SPECjbb2005 performance tests, which we conducted using a full enclosure of blades. Smaller solutions are better.

We used the average per-blade TCO to estimate the TCO for the solutions we show in Figure 4. As Figure 5 shows, HP and IBM solutions that deliver performance equivalent to one rack of the Dell blades have a significantly higher TCO than the Dell solution.

	Savings over performance-equivalent configurations			
	Dell over HP		Dell over IBM	
Acquisition costs	\$138,279	29.3%	\$87,950	20.8%
TCO for 1 year	\$147,988	27.9%	\$98,280	20.4%
TCO for 3 years	\$167,408	25.9%	\$118,940	19.9%
TCO for 5 years	\$190,259	23.4%	\$143,536	18.7%

Figure 5. Dell offers significant savings over performance-equivalent configurations from HP and IBM in acquisition costs and 1-, 3-, and 5-year TCO.

We provide details of this analysis in Appendix B.

Summary

Enterprises of all sizes are deploying or considering deploying blade systems as a way to consolidate resources and lower their total cost of ownership. These solutions tend to be easier to deploy and manage than traditional rack servers and offer lower energy consumption for both server power and cooling.

We calculated the total cost of ownership (TCO) for the Dell PowerEdge M-Series Blades, the HP BladeSystem c-Class, and the IBM BladeCenter H Type 8852. Our 1-, 3-, and 5-year TCO estimates included costs for hardware, support, management software, power, cooling, data center costs, and out-of-box setup.

We provided TCO comparisons using two methods of sizing solutions. Both use one rack of Dell blades as the basis of comparison:

- Same quantity – The first comparison sizes each solution to include 64 blades, the number of blades in one full Dell rack. This comparison provides views of per-rack, per-chassis, and per-blade TCO.
- Same performance – The second comparison uses SPECjbb2005 performance scores to size each solution so that it has the number of blades that would provide the same performance as one rack of Dell blades: 71 HP blades, and 73 IBM blades.

In both comparisons, the Dell PowerEdge M1000e blade solution had the lowest TCO and thus delivered significant savings over the HP and IBM solutions.

Appendix A – TCO details for per rack, per chassis, and per blade TCO

Our TCO analysis focuses on four key categories that vary among the blade solutions and for which we can provide test results or other hard data:

- hardware and support costs for the blade, enclosure, and rack
- costs for system management software
- facilities costs, including per-rack space costs, power costs, cooling costs, and Ethernet costs
- costs for out-of-box setup

We base power utilization and out-of-box setup costs on our hands-on comparisons of the blade solutions. Other cost data comes from vendor quotes or our experience.

Costs are for configurations that have the same number of blades as a rack in the Dell solution. The HP solution, like the Dell, includes 64 blades per rack, but the IBM solution supports only 56 blades per rack. For the IBM solution, a 64-blade configuration would include 8 blades in another enclosure on a second rack. Chassis costs are for 16 blades, the number of blades in a single chassis or enclosure for the Dell and HP solutions. For the IBM solution, which supports 14 blades in a full chassis, this 16-blade configuration would include 2 blades in a second chassis. We cost the additional IBM blades based on the proportional cost of each blade in a 56-blade rack. Figure 6 shows the rack costs. We divide those costs by four to get the per-chassis costs and by 64 to get the per-blade costs we present in the body of this paper.

NOTE

We ran our tests with Dell PowerEdge M600 blade enclosure. We provide cost data for the newer Dell PowerEdge M1000e enclosure. Dell tests show that the PowerEdge M1000e provides performance and energy savings over the earlier enclosure, so we are probably underreporting its savings by using figures from the older enclosure. Nonetheless, for our cost and performance analyses we assumed the same blades as in the original report.

Acquisition costs include the costs to purchase the blades, enclosures, and racks, as well as the one-time setup costs. The 1-, 3-, and 5-year costs include the acquisition costs plus annual facilities costs. Facilities costs include rack costs that reflect rack footprint, including clearances, power and cooling, and Ethernet port costs.

	Dell	HP	IBM
Acquisition costs			
Hardware and support	\$326,663	\$331,179	\$351,839
Management software	\$7,596	\$93,568	\$17,513
Out-of-box setup	\$95	\$1,288	\$887
Acquisition cost total	\$334,354	\$426,035	\$370,239
1-year costs			
Facilities costs	\$48,526	\$52,494	\$51,600
1-year total (includes acquisition costs)	\$382,880	\$478,529	\$421,839
3-year costs			
Facilities costs	\$145,578	\$157,482	\$154,800
3-year total (includes acquisition costs)	\$479,932	\$583,517	\$525,039
5-year costs			
Facilities costs	\$242,630	\$262,470	\$258,000
Blade and enclosure support costs	\$46,800	\$45,280	\$44,480
5-year total (includes acquisition costs)	\$623,784	\$733,785	\$672,719

Figure 6: Per-rack TCO for hardware, support, management software, facility, and setup, organized by acquisition costs and 1-, 3-, and 5-year costs. Rack costs are for configurations that have 64 blades, the number in the Dell solution.

The remainder of this appendix discusses the assumptions we made about the target business environment and costs. It also describes the cost categories.

Assumptions that affect calculated costs

To calculate TCO for rack, chassis, and blades, we made the following assumptions about the target business environment:

- The data center has management servers in place that administrators could use to deploy management software.
- The data center fills racks to capacity and has adequate power and cooling capacity for those full racks.

We made the following assumptions about costs:

- The blade servers are busy one-third of the time and idle the remaining time, and they run all day, every day. We use power measurements we took during periods of peak performance on SPECjbb2005 benchmark tests to estimate costs for the busy periods and power measurements we took while the servers were idle to estimate costs during idle times.
- Data center staff costs \$100 per hour for out-of-box setup.
- 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.⁵ Data centers may have different proportions of these costs because cooling efficiency and technology, rack densities, and other factors affect cooling costs.
- The enterprise has selected 24-hour-a-day, 7-days-a-week hardware support agreements with a 4-hour response time. Under these agreements, the vendor, not the data center staff, does the majority of hardware maintenance. We did not include any additional maintenance costs.
- The initial procurement includes 3-year support for blades and enclosures. Our 5-year TCO includes additional costs for 5-year support.
- We included no operating system or application software costs in our analysis, because these costs would vary widely among enterprises.
- The data center costs \$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.
- Each enclosure has two Gigabit Ethernet pass-through modules. We included a \$400 per server per year charge for Ethernet ports and related support.
- The data center costs for power and cooling are \$0.11 per kWh. We base this estimate on the Department of Energy's data⁶ on average commercial charges for May, 2008, of \$0.1006; we have rounded up this rate because of rising costs and because data centers are often in regions and cities with above-average rates.

Cost categories

Hardware and support costs

We configured and got cost data for the blade systems from the vendor's Web sites. We used list prices for all systems, because discounts vary by buyer and by vendor; this approach provides the most level playing field possible for our comparison.

⁵Estimating Total Power Consumption by Servers in the U.S. and the World, Jonathan G. Koomey, PhD, February 15, 2007 (<http://enterprise.amd.com/Downloads/svrpwusecompletefinal.pdf>)

⁶Energy Information Association: Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html

Our prices for the Dell solution include non-mission-critical support available 24 hours a day and 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-days-a-week service with a 4-hour response time that is available from the other vendors.

Management software costs

We include costs available on each vendor's Web site for standard management software. We added the Altiris Deployment Solution to the Dell and IBM management solutions, because it is a typical add-on to the standard management package for both vendors. We priced the following management software:

- Dell Open Manage plus Altiris Deployment Solution for Servers
- HP Insight Control Environment system management software
- IBM BladeCenter Advanced Management Module plus Altiris Deployment Solution for Servers

To avoid having to estimate future software costs, we assumed buyers would purchase the software as a one-time cost and would not pay for software upgrades during the solution's 3-to-5-year life cycle. Figure 6 shows the management software costs.

We also included costs for I/O virtualization software in our overall costs. Among other features, these products let you quickly change a failed blade without changing LAN or SAN addresses. Each of the vendors offers I/O virtualization software:

- Dell FlexAddress SD card
- HP Virtual Connect (includes Virtual Connect Kit and HP Virtual Connect Enterprise Manager)
- IBM BladeServer Open fabric manager

Facilities costs

We include costs for space, power, and cooling. We use power consumption data from our white paper comparing power and performance using SPECjbb2005. We calculated cooling costs based on the power measurements from that study.

We include Ethernet costs in our data center costs. These costs, which include switches, cables, support, and service, can be significant, particularly for vendors using the Gigabit Ethernet pass-through technology we have priced here. We estimate \$400 per blade per year for the Gigabit Ethernet pass-through solutions.

Businesses can potentially save significantly on port costs by installing switches rather than pass-through modules on the enclosures. Switches aggregate network traffic and, as a result, reduce both the number of cables per chassis and the number of costly ports the solution requires. In some enterprises, however, compatibility issues between the internal switches and the existing external infrastructure, security issues, or quality of service (QoS) needs eliminate this option. The choice is often a tradeoff between cost and performance.

Out-of-box setup costs

We use out-of box setup costs from our December 2007 study that compared the out-of-box experience of these three blade systems. We received each enclosure and set of blades in the manufacturer's original packaging. We then compared the amount of time it took to set up each system. Due to differences in packaging and design, there was a considerable difference in setup times for the three systems. We calculated the setup costs based on a \$100-per-hour cost and multiplied our results for one enclosure by four to get costs for out-of-box setup for the four enclosures in a full rack of blades. Vendors or third-party suppliers offer a range of deployment services for a fee that are an alternative to these out-of-box setup costs.

Appendix B – TCO details for performance-equivalent TCO

The solutions from different vendors or product lines that deliver comparable performance vary in size, complexity, and cost.

For our performance measure, we used results of SPECjbb2005 testing⁷ we conducted in February 2008. SPECjbb2005 is an industry-standard benchmark created by the Standard Performance Evaluation Corp. (SPEC) to measure a server's Java performance. The benchmark's results portray the server's throughput in business operations per second or SPECjbb2005 bops. A higher SPECjbb2005 bops result is better. (For more information on SPECjbb2005, go to www.spec.org.)

Our SPECjbb2005 tests show that at peak load the Dell PowerEdge solution delivered 9.5 percent greater performance than the HP solution and 13.9 percent greater performance than the IBM solution.

This difference in SPECjbb2005 bops translates into a significant difference in the number of individual blades a company needs to achieve comparable performance and in overall configuration size and cost.

Figure 7 summarizes our results for tests with a full chassis of blades; see the original report for the detailed results SPEC requires.

Dell	HP	IBM
212,740	194,341	186,850
	<i>The Dell score was 9.5 percent better than the HP score</i>	<i>The Dell score was 13.9 percent better than the IBM score</i>

Figure 7. Average SPECjbb2005 bops result per blade when we tested with full chassis. Higher scores are better.

We used our percentage comparisons of SPECjbb2005 bops results to estimate the number of blades each solution would require to deliver comparable performance. We used a full rack of Dell blades as the basis for our comparison. Because the Dell score was 9.5 percent better than the HP score and 13.9 percent better than the IBM score, we included 9.5 percent more blades for the HP solution and 13.9 percent more for the IBM solution. We rounded our results up to the nearest blade and show those results in Figure 8.

Dell	HP	IBM
64 blades	71 blades	73 blades
	<i>9.5 percent more than the Dell⁸</i>	<i>13.9 percent more than the Dell⁹</i>

Figure 8. Estimated size of solutions needed to deliver performance equivalent to one rack of the Dell solution. We base estimates on ratios of the results of our SPECjbb2005 results, which we conducted using a full enclosure of blades. We round up fractional results and present results as whole numbers of blades.

⁷ For more information about these tests, see our February 2008 report: Windows Server 2008 SPECjbb2005 performance and power consumption on Dell, HP, and IBM blade servers (http://www.principledtechnologies.com/Clients/Reports/Dell/Win2K8_blades0208.pdf). SPEC[®] and the benchmark name SPECjbb2005[®] are registered trademarks of the Standard Performance Evaluation Corporation. Results are the median of three test runs. We ran our tests with the Dell PowerEdge M600 but provide cost data for the newer Dell PowerEdge M1000e enclosure. For our cost and performance analyses, we assumed the same model blades as in the original report.

⁸ Windows Server 2008 SPECjbb2005 performance and power consumption on Dell, HP, and IBM blade servers (http://www.principledtechnologies.com/Clients/Reports/Dell/Win2K8_blades0208.pdf) and Out-of-Box Comparison between Dell, HP, and IBM servers (<http://www.principledtechnologies.com/Clients/Reports/Dell/DellHPIBMbladeserverOOB1207.pdf>)

⁹ Ibid.

We used our average TCO-per-blade values from Appendix A to estimate the TCO for the blade counts we show in Figure 8. As Figure 9 shows, HP and IBM solutions delivering equivalent performance to one rack of the Dell blades cost significantly more than the Dell solution.

	Dell	HP	IBM
Acquisition costs			
Hardware and support	\$326,663	\$367,402	\$401,316
Management software	\$7,596	\$103,802	\$19,976
Out-of-box setup	\$95	\$1,429	\$1,012
Acquisition cost total	\$334,354	\$472,633	\$422,304
1-year costs			
Facilities costs	\$48,526	\$58,236	\$58,856
1-year total (includes acquisition costs)	\$382,880	\$530,868	\$481,160
3-year costs			
Facilities costs	\$145,578	\$174,707	\$176,569
3-year total (includes acquisition costs)	\$479,932	\$647,340	\$598,872
5-year costs			
Facilities costs	\$242,630	\$291,178	\$294,281
Blade and enclosure support costs	\$46,800	\$50,233	\$50,735
5-year total (includes acquisition costs)	\$623,784	\$814,043	\$767,320

Figure 9: TCO for performance-equivalent configurations with costs for hardware, support, management software, facility, and setup organized by acquisition costs and 1-, 3-, and 5-year costs.

About Principled Technologies

We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools. 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, and white papers. Every document reflects the results of our trusted independent analysis.

We provide customized services that focus on our clients' individual requirements. Whether the technology involves hardware, software, Web sites, or services, we offer the experience, expertise, and tools to help you assess how it will fare against its competition, its performance, whether it's ready to go to market, and its quality and reliability.

Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 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.



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