Reducing the power consumption of HP ProLiant servers in the data center

Technical white paper

Table of contents

Executive summary ................................................................. 2
Introduction ............................................................................. 3
HP Insight Control power management .......................................... 3
Server features ......................................................................... 4
  Increasing fan efficiency ........................................................ 4
  Using solid state drives ......................................................... 5
  Using low-power options ....................................................... 6
Benefits of low-power processors .................................................. 6
  Tested server ........................................................................ 6
  Test methodology ................................................................ 6
  Results .................................................................................. 7
Using consolidation to reduce consumption ....................................... 7
  Virtualization with consolidation ............................................ 8
  Virtualizing x86 servers ...................................................... 9
  Reducing the number of servers required in the data center .......... 9
Conclusions .............................................................................. 11
Appendix A: Dynamic Power Capping ........................................... 12
  Server blade models .......................................................... 12
  Tower and rack mount models ............................................. 13
For more information ................................................................ 14
Executive summary

According to The Green Grid, a global consortium of IT companies (including HP) and professionals seeking to improve energy efficiency in data centers around the globe, “the cost of power and cooling the IT infrastructure approaches and even exceeds the cost of acquiring the assets themselves1.” This increase in cost has captured the attention of CIOs; as a result, many IT organizations are being asked to find creative ways to reduce power consumption and better utilize existing facilities, while maintaining or improving the quality of IT service delivery.

Moreover, many data centers are encountering limits imposed by utility companies on the power capacity available for their operations. Gone are the days when IT staff could assume they had all the power and cooling they needed to support the growing demand for IT services.

In response, these IT organizations are focusing on conserving and optimizing their usage of power and cooling resources. However, their efforts are being inhibited by an inability to effectively monitor and control consumption.

This white paper outlines power-management capabilities of HP Insight Control that can be used to deliver real-time, around-the-clock insight into actual power consumption in the data center, conserve power without performance impact using power-regulation technology built into HP ProLiant servers, and reclaim excess power provisioned in the data center by limiting peak power consumption. In addition, HP ProLiant server hardware can reduce power consumption through features like improved fan cooling, solid-state drives (SSDs), and low-power options.

A study performed by HP concluded that per-processor power consumption may be reduced by over 26% on a server blade equipped with low-power processors, with a performance penalty of only 16%.

More significant power savings can be achieved by consolidating large numbers of legacy servers on to a few, modern HP ProLiant servers; virtualization may further reduce power consumption while delivering additional benefits in the areas of manageability, high availability, and disaster recovery. Fewer servers also translates to a large reduction in the amount of heat generated — and, thus, lower cooling costs — and frees up data center space for other uses.

Thus, despite reduced budgets, data center managers now have a range of options for addressing server sprawl, lack of data center floor space, and power/cooling capacity constraints. For example, you can utilize a management software product such as HP Insight Control to address problems at the data center level by imposing power thresholds. Alternatively, you can respond at the component level by using low-power processors and memory, or solid-state drives (SSDs). A third option is to deploy technologies like consolidation and virtualization to free up valuable data center resources. Ideally, you should consider implementing all three of these options.

**Target audience:** This white paper is intended for IT professionals needing solutions to address data center power, cooling, and space constraints.

This white paper references legacy server testing performed in August 2006. HP ProLiant BL460c/BL465c G6 server blades were tested in October 2008 – September 2009.

---

1 “The Green Grid Opportunity Decreasing Datacenter and Other IT Energy Usage Patterns”
Introduction

There are multiple issues facing the data center manager today, including the following:

- **Current recession**
  Budgets have typically been cut to levels that can barely keep up with existing data center requirements – and certainly not be used to support new go-to-market opportunities.

- **Existing data center capacity**
  Power, cooling, and space requirements have reached critical levels that, without a paradigm shift, can only be accommodated by expanding the data center, a very expensive option.

- **Reliability and redundancy**
  24 x 7 access to applications and data is a requirement in today’s data center; thus, anything that impacts the infrastructure can also impact the bottom line.

This paper describes hardware and software features of HP ProLiant servers that can optimize power consumption, and explores readily-available solutions from HP and Citrix that can be used to address server sprawl in the data center, which translates directly into reduced power consumption, lower cooling requirements, and an increase in available floor space.

Thus, you can conserve valuable resources in your data center by selecting from the range of software, hardware, and consolidation/virtualization solutions outlined below.

**HP Insight Control power management**

HP Insight Control unlocks the management capabilities built into your HP ProLiant servers, allowing you to manage server health – whether physical or virtual – proactively, deploy your servers quickly, and optimize power consumption.

Rising energy costs are probably forcing you to re-evaluate how you manage power consumption in your data center. If you are faced with half-filled racks, a lack of power and cooling capacity, and no budget, you will have to abandon traditional techniques, such as budgeting your power consumption based on worst-case figures stamped into product faceplates – excess capacity that may never be used. You need more precise ways to measure actual, real-time power usage, along with mechanisms to control the amount of power being consumed.

HP Insight Control power management provides the following core capabilities, designed to help you regain control of your valuable power and cooling resources:

- **Power measurement**
  By monitoring metered power distribution units (PDUs), HP Insight Control delivers real-time, around-the-clock insight into actual power consumption in your data center. Now, for example, you can create graphs showing up to three years of peak and average consumption by HP ProLiant servers and HP BladeSystem enclosures. Leveraging this information, you can set realistic dynamic power caps (explained below) and export accurate metrics on power and cooling to other reporting tools, allowing you to compare your power budget against actual usage.

- **Power regulation**
  You can conserve power without performance impact using power-regulation technology built into HP ProLiant servers. For example, the server’s power states can be adjusted automatically based on the requirements of the particular workload, allowing you to fully utilize the capabilities of your server when needed, while conserving power when the workload is less-demanding.
• **Power capping**
  
  The Dynamic Power Capping capability offered by HP ProLiant servers and HP BladeSystem helps you reclaim excess power provisioning in your data center by safely limiting peak power consumption without impacting performance.

  Dynamic Power Capping can quickly bring a server experiencing a sudden increase in workload back under a user-specified power level. This ability to control consumption makes Dynamic Power Capping an effective tool for the planning and management of power and cooling in the data center. Now you need only provision as little as 50% or less of the power rating specified on a server’s faceplate.

---

**Note**

For more information on total cost of ownership (TCO) benefits that may be achieved by a Dynamic Power Capping implementation, refer to the HP white paper, “Dynamic Power Capping TCO and Best Practices White Paper.”

---

For more information on downloading Dynamic Power CAPPING and system prerequisites, refer to Appendix A: Dynamic Power Capping.

---

**Server features**

This section outlines hardware solutions that can be used to reduce the power consumption of HP ProLiant servers.

**Increasing fan efficiency**

HP builds a broad range of functionality, such as thermal sensors and fan control algorithms, into HP ProLiant servers to help reduce requirements for power and cooling.

Initially, when CPUs were the primary producers of heat in the server, most thermal sensors were deployed in this particular zone so that fans – heavy users of electricity – were only switched on when required to prevent the CPU from overheating. As memory modules have become denser, however, the primary heat source has shifted; in response, Double Data Rate 3 (DDR3) dual inline memory modules (DIMMs) deployed in G6 and later HP ProLiant servers incorporate reliable on-die thermal sensors to better control the heat generated by memory.

In addition to CPU and memory, fans are also required to cool hard disk drives (HDDs). Thus, on older systems, fans were all required to operate at full speed even if only one of these three zones needed to be cooled.

Modern systems utilize zoned fans working in conjunction with large numbers of thermal sensors – often referred to as a sea of sensors. Using information collected from these sensors, a sophisticated control algorithm identifies specific components that require cooling; the fan speed for each zone is adjusted accordingly so that full speed is only used where necessary.

In addition, some servers provide a ROM-based setup utility (RBSU) that allows you to manually increase fan speed when additional cooling is required.

---

2 You can use Citrix XenApp load balancing to send future session connections to other servers.
Using solid state drives

Quicker, tougher, quieter solid state drives (SSDs) – as opposed to traditional hard disk drives (HDDs) – are based on flash memory and therefore have no moving parts. SSDs offer several benefits, including faster data access and lower power and cooling requirements.

While the lower capacities and relatively high cost of SSDs have inhibited their mainstream adoption, their prices have continued to drop. As a result, SSDs have become a viable option for targeted storage in HP ProLiant servers.

Because of the extremely high I/O rates supported by SSDs, the amount of power consumed per I/O is significantly lower than for an HDD. Thus, enterprise applications that need a large number of spindles to achieve a high random I/O rate might consume much less power if SSDs were used.

SSD performance may be an issue with certain applications. Faster access times allow the SSD to outperform an HDD when running certain tasks; for example, an SSD is typically more responsive (quicker to boot, come out of standby mode, or launch an application) and can run many sequential I/O tasks in less time. However, because of the inherent inability of flash memory to quickly write data to different cells, an HDD is far superior with applications requiring random writes – as in many Citrix XenApp environments. Indeed, the slower writes associated with an SSD might cause a bottleneck if multiple write requests were received simultaneously.

Thus, while an SSD may consume as much as 50% less power than a 15,000 RPM HDD, you should consider the following:

- SSDs are significantly more expensive than HDDs of a similar size
- The write speed of an SSD is slow, though read speed is fast
- Since cells can only be written to a finite number of times, SSDs have finite lifecycles:
  - 10,000 times for consumer-grade, multi-level cell (MLC) NAND
  - 100,000 times for high-performance, enterprise-scale, single-level cell (SLC) NAND

Summary

HP offers the following guidelines for deploying SSDs:

<table>
<thead>
<tr>
<th>Recommended</th>
<th>Less-effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Random memory accesses</td>
<td>- Sequential data accesses</td>
</tr>
<tr>
<td>- Read-intensive applications</td>
<td>- Write-intensive applications</td>
</tr>
<tr>
<td>- Severe environmental conditions</td>
<td>- Typical environmental conditions</td>
</tr>
<tr>
<td>- Severe space constraints</td>
<td>- Average space constraints</td>
</tr>
<tr>
<td>- Severe power constraints</td>
<td>- Average power constraints</td>
</tr>
</tbody>
</table>

HP provides SSD and HDD products that can meet your unique needs. If your focus is entirely on conserving power, consider using an SSD, which only consumes around 2 W while a typical HDD uses up to 8 W. When your requirements match the ideal SSD usage scenario, savings from lower per-unit wattage can quickly add up in today’s saturated data centers.

---

Using low-power options

Another server feature that can be used to reduce power and cooling requirements is support for low-power components, which can often be used to replace full-power options without significant performance penalty.

Take, for example, the HP ProLiant BL465c G6 server blade, which can be configured with AMD Opteron™ processors Model 2435 (75 W) or Model 2425 (55 W); low-power memory kits are available; and, rather than 15,000-rpm HDDs, you can use more efficient 10,000-rpm HDDs.

See below for the results of a study performed by HP to characterize the performance penalty imposed by the use of low-power processors.

Benefits of low-power processors

To demonstrate the benefits of low-power processors, HP carried out a study to compare the performance of an HP ProLiant BL465c G6 server blade equipped with 55-W processors in a 64-bit XenApp environment with that of a similarly-configured blade equipped with faster 75-W processors. Bare-metal and virtualized blades were tested.

Tested server

The tested server was a 2P/6C 4 HP ProLiant BL465c G6 server blade configured as follows:

- AMD Opteron processor Model 2435 (2.6 GHz/75 W) or Model 2425 HE (2.1 GHz/55 W)
- 6 MB shared L3 cache
- 32 GB RAM
- Two 146-GB 10,000-rpm SAS hard drives, configured with RAID 0

Test methodology

To simulate a typical workload in the XenApp test environment, HP used a script based on the Heavy User profile whereby Heavy Users – also known as Structured Task Workers – tend to open multiple applications simultaneously and remain active for long periods. Heavy Users often leave applications open when not in use. User activities utilized Microsoft® Office 2003.

To obtain a baseline, HP began with a bare-metal blade configured with 75-W processors. Testing was initiated by running the workload with a group of 15 simulated users; start times were staggered to eliminate authentication overhead. After these sessions finished, HP added 15 more users, then repeated the testing. Further users were added until the optimal number 5 of users was identified.

The following configurations were tested for comparison with the full-power, bare-metal blade:

- Virtualized blade, 75-W processors
- Bare-metal blade, 55-W processors
- Virtualized blade, 55-W processors

---

4 Denoting two processors (P), each with six cores (C), for a total of 12 cores

5 Typically, the number of users active when processor utilization reaches 80%
Results

As shown in Figure 1, per-processor power consumption was reduced by over 26% on the blade equipped with low-power processors, with a performance penalty of only 16%.

![Figure 1. Optimal numbers of users supported by the blade when equipped with 75-W and 55-W processors](image)

**Note**
Optimal numbers of users supported by bare-metal and virtualized blades were identical.

Using consolidation to reduce consumption

Many XenApp deployments include servers that are dedicated to hosting single applications. Though promoting server sprawl – and associated manageability issues – this approach may make sense if resource utilization on these servers remains high. If resource utilization is low, however, consolidation can be beneficial.

For example, in testing performed in August 2006, HP found that an x86 HP ProLiant BL460c first-generation server blade platform was able to support 96 users running an Office 2003 workload. Based on this level of scalability, 16 of these legacy blades would be required to support 1,500 Office 2003 users. However, a study performed by HP (described below), indicates that it took far fewer modern blades to run the same workload, driving significant reductions in the power, cooling, and space consumed in the data center. See Figure 2.

---

616 x 96 = 1,536 users
Virtualization with consolidation

IT organizations are being challenged to improve resource utilization, reduce power consumption, strengthen security, improve reliability, and become more responsive to rapidly changing business needs. Many have recognized that virtualization deployed in conjunction with consolidation can help meet all these objectives, while delivering a broad range of additional benefits, including the following:

- Since they are isolated, virtual machines (VMs) can be configured to use specific hardware resources
- VMs are easy to copy and deploy, and may be moved between physical hosts without service disruption
- VMs can be administered centrally
- Access to VMs can be provided by thin clients to enhance data security, simplify desktop management, and reduce total cost of ownership for the desktop

Thus, virtualization lends itself to applications such as high availability and disaster recovery.

Note:
For more information on the benefits of virtualization, refer to the HP white paper, “Virtualization of HP Server Based Computing environment with Citrix XenServer.”

However, many IT organizations have found it difficult to select a suitable virtualization software stack for their HP ProLiant servers. Historically, the benefits of virtualization solutions have been offset by a significant performance overhead, with many fewer users being supported on a virtualized server than on a similarly-configured bare-metal system. However, with Citrix XenServer running on high-performance HP ProLiant servers, scalability concerns have been far outweighed by the benefits delivered by this virtualization platform, in part because newer, multi-core AMD Opteron and Intel® Xeon® processors have specifically been designed to support virtualization.
Now, virtualization can be used in conjunction with consolidation to lower the number of servers required in a XenApp environment, reducing the physical footprint as well as power and cooling requirements within the data center.

Virtualizing x86 servers

In practice, the scalability of x86 platforms has been restricted by inherent kernel memory limitations; thus, IT organizations have typically been unable to fully utilize the computing power delivered by higher-end servers. As a result, consolidation in the x86 environment has been impractical for most scenarios. However, with the introduction of powerful, modern HP ProLiant servers, test results indicate that a virtualized x86 platform may now be able to support as many – or more – users compared to an x64 platform (whether virtualized or not). These results demonstrate that virtualization may be the key to unleashing the power of today’s high-performance servers in an x86 environment, as demonstrated by the following study.

Reducing the number of servers required in the data center

HP conducted a study to demonstrate how power consumption in the data center can be significantly reduced using modern HP ProLiant servers. The baseline for the study was a legacy configuration of 16 HP ProLiant BL460c first-generation server blades that was able to support the workload generated by 1,500 Microsoft Office users. The study utilized HP ProLiant BL456c G6 and BL460c G6 blades to determine the minimum number of these blades required to support the same workload with at least 1,500 Office users.

HP compared server performance in a XenApp environment utilizing the following scenarios:

- x86 or x64
- Bare-metal or virtualized
- Full-power (75-W) or low-power (55-W) processors

The HP BladeSystem Power Sizer (BPS) tool was used to develop key metrics for each tested configuration, including price per user, power consumed per user, and heat generated per blade. The BPS can help you plan a specific HP BladeSystem solution that includes power and cooling requirements, total cost, and a detailed Bill of Materials (BOM).

Note:
For more information on the performance testing (including configurations, methodology, and results), refer to the following sources: BL465c G6 or BL460c G6.

Results

Table 1 summarizes the results of the study, listing the number of HP ProLiant BL465c G6 or BL460c G6 server blades required by each of the test scenarios to support the workload of 1,500 Office users.

---

Footnote: For more information on the BPS, refer to http://h71019.www7.hp.com/ActiveAnswers/cache/347628-0-0-0-121.html. Power requirements and pricing used in this white paper were developed in July 2009; values for the heat generated by a particular configuration were developed in February 2010.
The price-per-user metric is intended to be representative rather than truly comprehensive. For example, the overall pricing does not include operating system licenses or conventional management software, nor does it include software for managing VMs in an enterprise environment (which can deliver significant benefits). Pricing for virtualized servers does include HP Virtual Connect Technology, which provides change-ready connectivity for servers and VMs.

Power-per-user metrics generated by the BPS are based on actual component-level power measurements for systems stressed to their maximum capabilities.

Table 1. Number of modern HP ProLiant server blades required to support the workload of 1,500 Office users

<table>
<thead>
<tr>
<th>Metric</th>
<th>BL465c G6 75 W</th>
<th>BL465c G6 55 W</th>
<th>BL460c G6 75 W</th>
<th>BL460c G6 55 W</th>
<th>BL460c first-gen. 75 W</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virtualized</td>
<td>5x64</td>
<td>5x64</td>
<td>5x64</td>
<td>5x64</td>
<td>5x64</td>
</tr>
<tr>
<td>x86</td>
<td>4x64</td>
<td>4x64</td>
<td>4x64</td>
<td>4x64</td>
<td>4x64</td>
</tr>
<tr>
<td>Power per user (W)</td>
<td>1.3</td>
<td>1.1</td>
<td>1.3</td>
<td>1.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Price per user ($)</td>
<td>28.24</td>
<td>33.75</td>
<td>33.02</td>
<td>29.92</td>
<td>32.50</td>
</tr>
<tr>
<td>Number of blades</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Clearly, modern HP ProLiant server blades can reduce power consumption in the data center by as much as 74% (without considering cooling) following the consolidation of a legacy environment. Significant space – up to 75% – has been freed up within the HP BladeSystem enclosure to support new applications, additional users, or higher service levels.

Virtualization, particularly in an x86 environment, can drive additional power savings. Table 1 shows the average price penalty for the broad range of benefits delivered by virtualization to be only 19%\(^9\).

Figure 3 demonstrates that reducing the number of servers causes the consolidated configurations to generate as much as 76% less heat than the legacy environment, translating to significantly lower cooling costs for the data center\(^10\).

---

\(^8\) Denotes bare-metal

\(^9\) Additional software may be required to support applications such as high availability and disaster recovery

\(^10\) Based on BPS calculations performed in February 2010
Figure 3. Heat generated (in BTU/hour) by bare-metal configurations featuring HP ProLiant BL465c G6 (full-power), BL460c G6, and BL460c first-generation server blades; the number of blades in each configuration is noted.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Heat Generated (BTU/hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL465c G6</td>
<td>4x: 5,678</td>
</tr>
<tr>
<td></td>
<td>5x: 8,022</td>
</tr>
<tr>
<td>BL460c G6</td>
<td>4x: 5,513</td>
</tr>
<tr>
<td></td>
<td>5x: 7,820</td>
</tr>
<tr>
<td>BL460c G1</td>
<td>16x: 23,194</td>
</tr>
</tbody>
</table>

Conclusions

Despite reduced budgets, data center managers now have a range of options for addressing server sprawl, lack of data center floor space, and power/cooling capacity constraints. For example, you can utilize a management software product such as HP Insight Control to address problems at the data center level by imposing power thresholds. Alternatively, you can respond at the component level by using low-power processors and memory, or SSDs. A third option is to deploy technologies like consolidation and virtualization to free up valuable data center resources. Ideally, you should consider implementing all three of these options.
Appendix A: Dynamic Power Capping

This appendix provides support matrices for Dynamic Power Capping on HP server models. For more information, refer to http://h18004.www1.hp.com/products/servers/management/dynamic-power-capping/support.html.

HP Insight Control, which includes the Dynamic Power Capping feature, is available for download at http://h18004.www1.hp.com/products/servers/management/fpdownload.html as part of the latest HP Insight Software DVD.

Server blade models

Table A-1 provides a support matrix for HP blades that support the following functionality:

- Enclosure Dynamic Power Capping
- Power Regulator (some processor models may not be supported; for more information, refer to http://h18013.www1.hp.com/products/servers/management/ilo/power-regulator.html)
- Inlet air temperature

Enclosure prerequisites include the following:

- Redundant Onboard Administrator
- N+N redundant power configuration
- HP Integrated Lights-Out 2 (iLO 2) Advanced license

Table A-1. Minimum firmware and software levels required on HP ProLiant server blades to support Enclosure Dynamic Power Capping

<table>
<thead>
<tr>
<th>Platform</th>
<th>iLO 2 Advanced</th>
<th>Onboard Administrator</th>
<th>System BIOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL280c G6</td>
<td>1.77</td>
<td>2.41</td>
<td>4/2/09</td>
</tr>
<tr>
<td>BL460c first-generation</td>
<td>1.70</td>
<td>2.30</td>
<td>11/2/08</td>
</tr>
<tr>
<td>BL460c G5</td>
<td>1.70</td>
<td>2.30</td>
<td>11/2/08</td>
</tr>
<tr>
<td>BL460c G6</td>
<td>1.77</td>
<td>2.41</td>
<td>3/28/08</td>
</tr>
<tr>
<td>BL490c G6</td>
<td>1.77</td>
<td>2.41</td>
<td>3/28/08</td>
</tr>
<tr>
<td>BL495c G5</td>
<td>1.70</td>
<td>2.30</td>
<td>11/2/08</td>
</tr>
<tr>
<td>BL495c G6</td>
<td>1.77</td>
<td>2.41</td>
<td>4/6/09</td>
</tr>
<tr>
<td>BL685c G6</td>
<td>1.77</td>
<td>2.41</td>
<td>4/6/09</td>
</tr>
<tr>
<td>BL2x220c G5</td>
<td>1.70</td>
<td>2.30</td>
<td>11/3/08</td>
</tr>
<tr>
<td>xw2x220c</td>
<td>1.70</td>
<td>2.30</td>
<td>11/2/08</td>
</tr>
<tr>
<td>xw460c</td>
<td>1.70</td>
<td>2.30</td>
<td>11/1/08</td>
</tr>
</tbody>
</table>
Tower and rack mount models

Table A-2 provides a support matrix for HP tower and rack mount server models that support the following functionality:

- Dynamic Power Capping
- Power Regulator (some processor models may not be supported; for more information, refer to http://h18013.www1.hp.com/products/servers/management/ilo/power-regulator.html)
- Inlet air temperature

An iLO 2 Advanced license is required.

Table A-2. Minimum firmware and software levels required on HP ProLiant tower and rack mount server models to support Dynamic Power Capping

<table>
<thead>
<tr>
<th>Platform</th>
<th>iLO 2 Advanced</th>
<th>System BIOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DL320 G6</td>
<td>1.77</td>
<td>3/29/09</td>
</tr>
<tr>
<td>DL360 G5*</td>
<td>1.70</td>
<td>11/2/08</td>
</tr>
<tr>
<td>DL370 G6</td>
<td>1.77</td>
<td>3/29/08</td>
</tr>
<tr>
<td>DL380 G5</td>
<td>1.70</td>
<td>11/2/08</td>
</tr>
<tr>
<td>DL380 G6</td>
<td>1.77</td>
<td>3/28/08</td>
</tr>
<tr>
<td>DL385 G6</td>
<td>1.77</td>
<td>4/6/09</td>
</tr>
<tr>
<td>ML330 G6</td>
<td>1.77</td>
<td>3/29/08</td>
</tr>
<tr>
<td>ML350 G6</td>
<td>1.77</td>
<td>3/29/08</td>
</tr>
<tr>
<td>ML370 G6</td>
<td>1.77</td>
<td>3/29/08</td>
</tr>
</tbody>
</table>

* With quad-core “G-step” system board
For more information

HP Insight Control


HP Thermal Logic technologies for HP BladeSystem

HP Solid State Drives Gen 2

HP ProLiant options

Citrix XenApp

Citrix XenServer

To help us improve our documents, please provide feedback at