Hewlett Packard's ProCurve 5406zl switch was evaluated by Miercom under the Certified Green Test Program for power consumption and efficiency. We analyzed the overall environmental impact and business enabling green benefits that the ProCurve 5406zl affords enterprise customers.

The HP ProCurve 5406zl proved in testing and by analysis to afford customers a switching solution with superior value, effectiveness, and energy efficiency. HP’s technology and its holistic approach to reduce environmental impact helps it's customers to significantly improve their ROI (Return on Investment).

HP ProCurve 5406zl is a 5U chassis type switch, designed with a modular blade configuration. Replaceable and upgradeable components include power supplies, a fan module and a management module. The HP ProCurve 5406zl switch is capable of supporting two internal energy efficient power supplies and two external redundant power supplies, used for external connectivity and uplink.

The total annual running cost is shown in Figure 1. Based on the testing metrics, the HP ProCurve 5406zl switch can provide the consumer with a savings up to 45%. (continued on page 3)
How We Did It

The Hewlett-Packard ProCurve 5406zl switch was evaluated for environmental impact by looking at the individual components as well as features and capabilities. Testing focused on the power consumption and efficiency of the product. A full audit was conducted to analyze the overall product-specific environmental impact.

Lab testing of each feature was conducted for power consumption under load as well as measurements and audit results verified with site survey assessments. The ProCurve 5406zl switch testing was configured and tested with a ProCurve 24 port Gig-T zl module, five ProCurve 4 port 10G-CX4 zl modules and one ProCurve 5400zl Switch Management Module.

Measuring Power Consumption: The power consumption of HP ProCurve 5406zl switch was measured by varying the traffic load and CPU utilization. Power consumption was measured and tested using a Dranetz Encore 61000 Power Analyzer from Dranetz-BMI (www.dranetz-bmi.com). The SUT was loaded with traffic at various rates and packet sizes in accordance with RFC 2544 Benchmarking Methodology for Network Interconnect Development. Power consumption measurements were taken during system boot-up, with one power supply until it reached an idle state. Power consumption of the HP ProCurve 5406zl chassis was measured while running the traffic through the 1 Gbps and 10 Gbps ports and stressing the product with the features it supports, while providing PoE power at a class 2 (7W) level of service. Additional power supplies were incrementally added as well as 10 Gbps Ethernet adapters. Measurements were taken at both 110 and 220 volts.

PoE Switch Analysis: The PoE load test was performed using a 5389ET 6-port PoE/PoE+ simulator. Power measurements were taken on the HP ProCurve 5406zl while providing PoE power at a class 2 level of service per port. We also used the Ixia XM2 and the Ixia 1600T traffic generators from Ixia (www.ixiacom.com) to obtain a full environmental reading spectrum with a mix of traffic on each port at different processor utilization rates. Miercom recognizes Ixia as an industry leader in energy efficiency testing of networking equipment. Ixia’s unique approach utilizes coordination of energy measurements with network traffic load – allowing energy consumption to be graphed against network traffic volume. Real-world traffic is generated by Ixia’s test platform and test applications, principally IxNetwork for layer 2-3 routing and switching traffic and IxLoad for layer 4-7 application traffic.

Environmental Analysis: Miercom’s environmental review of the HP ProCurve 5406zl switch also entailed an examination of the HP company-wide and product-specific environmental impact reduction efforts. We visited the Sacramento recycling location and interviewed HP personnel regarding the environmental-related features of the equipment and applications. Analysis includes comparisons to industry averages for competitive products that were also tested.
The chassis supports hot swappable modules, a fan module that spans the full height of the chassis, holding two fan modules in a 2x2 configuration, two internal power supplies and two external redundant power supplies. The switch supports up to six ProCurve interface modules, multiple speed 144 10/100/1000 auto sensing ports, utilizing 24 10G ports or Mini-GBICs (SFP+) slots for copper and optical connectivity to the network edge.

**Power Efficiency**

Figure 2 illustrates the power profile of the HP ProCurve 5406zl switch. An analysis was performed measuring the idle power consumed by the device during different stages, i.e., one power supply, two power supplies, operating at 110V and 220V as well as the connection of all active links. We tested both the 110V and 220V and an expected 5-10 W improvement resulted with 220V. The initial system boot power consumption is 72 W and increases to 283 W until idle state is reached. Total consumption is 314 W, once maximum traffic load is applied.

The HP ProCurve 5406zl switch requires only one power supply to operate the chassis. However, it can support two internal power supplies and two external power supplies for PoE and redundancy. These power supplies provide efficient power to the switch, generating less heat and reducing consumption. In the event of a power supply failure, the redundant power supply will provide continuous power to the switch, maximizing switch reliability.

HP has installed specific components on the HP ProCurve 5406zl switch that allow the device to operate at higher internal temperatures, which reduces the cooling required for the switches. The device is equipped with a fan module, featuring two variable-speed cooling fans. Using internal temperature sensors, the HP ProCurve 5406zl switch conserves energy by reducing fan speed when less cooling capacity is needed. The 5406zl switch also operates at lower average power usage, per port.

As shown in Figure 3 on page 4, while applying Layer 2 traffic, 100% load uses 314 Watts vs. 847 Watts at Industry Average, a 63% reduction. With a 70% load, the ProCurve 5406zl switch uses 312 Watts of power vs. 616 Watts at Industry Average, a 50% reduction. At Idle, the ProCurve 5406zl switch uses 283 Watts vs. 401 Watts of power at Industry Average, a 30% savings.

While applying Layer 3 traffic, 100% load uses 289 Watts vs. 847 Watts at Industry Average, a 66% reduction. With a 70% load, the ProCurve 5406zl switch uses 288 Watts of power vs. 616 Watts at Industry Average, a 54% reduction. At Idle, the ProCurve 5406zl switch uses 283 Watts vs. 401 Watts of power at Industry Average, a 30% savings.

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**Figure 2**

The Power Profile chart illustrates impact of power utilized for the HP ProCurve 5406zl switch, from initial boot-up to steady state at various load points. We observed an average consumption of 312 W and a peak consumption of 314 W at full load. Testing performed with 220V main supply.
**Product Efficiency**

The HP ProCurve 5406zl switch enables businesses to maximize efficiency of data center resources. The ProCurve Manager (PCM) provides an interface for remote identification and management of assets. The switch chassis is modular in design and enables greater port-density, lower average power usage per port and enhanced features and management tools.

The hardware supports additional add-on security software with Identity Driven Manager (IDM) and Network Immunity Manager (NIM). An administrator can set security policies remotely and proactively defend the network from malicious attacks.

PCM has an event driven “scriptable” interface that provides remote administration of power on a per port basis. Specific ports can be shut down when not in use. This allows flexibility in design by allowing customers to effectively manage the power consumption through “set” commands, thereby, reducing energy cost.

HP provides up to 15.4 W per port to the IEEE compliant 802.3af PoE devices such as IP phones, wireless access points and security cameras. In addition, granular power allocation using Link Layer Discovery Protocol-Media Endpoint Discovery (LLDP-MED) is supported. This granular control saves energy and also helps customers to optimally select the size of the UPS. It maximizes the efficiency of the upstream power draw.

With POE port prioritization in use, the administrator can allocate a priority to end devices based on the criticality to the business. Through ProCurve’s distributed computing design, the intelligence of the network chip is distributed among the management module and the interface modules. This master-slave architecture optimizes the power consumption based on the utilization of the chassis. Less power is used when fewer modules are utilized.

In addition, the ProCurve 5406zl switch supports end-span power for the PoE and provides software functionality to turn off unused PoE ports through PCM+ (ProCurve Manager Plus) or via Command Line Interface (CLI), thereby, utilizing fewer resources, resulting in a reduction of power consumption.

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**Figure 3**

The power consumption of the HP ProCurve 5406zl switch was tested under load conditions with 100%, 70% and at Idle-state utilization, while applying a Layer 2 and Layer 3 traffic load and is compared to the industry average for products in this class, realizing a 30% to 66% savings.
The internal power supplies on the HP ProCurve 5406zl switch are hot swappable and upgradeable as new more efficient technology becomes available, providing power redundancy; reducing operational costs and power consumption, while extending the service life of the equipment. The hot swappable, upgradeable fan module also allows for efficient cooling through its variable speed operation, easy replacement and maintenance, also minimizing energy costs while extending service life.

Upgrading the HP ProCurve 5406zl switch with next generation Application-Specific Integrated Circuit (ASICs) causes the module to be even more efficient. In addition, the crossbar switching fabric allows the power supplies and interface modules to be interchanged for the 8200 and 5400 switch series, providing scalability for flexible network solutions.

A “Locate LED” is installed on the ProCurve 5406zl switch and indicates whether a fault has occurred on an individual port, one of the switch modules, power supplies or one of the fan modules. Using a management interface device, the site administrator can remotely administer the network and locate the fault. The LED light indicator reveals the “problem” switch or module; the network is diagnosed and administered remotely, reducing energy consumption through more effective use of IT resources.

**Manufacturing**

An audit confirmed that HP ProCurve designs products with environmental impact minimization and efficiency in mind. The HP ProCurve 5406zl switch does not utilize a multi-core processor. Instead, it uses a distributed computing model. The network chip intelligence is distributed into each of the interface modules. This master-slave architecture ensures that the device power consumption is optimized.

**Business Processes**

For best practices, the equipment on the HP ProCurve 5406zl switch can be configured to economize the power consumption of the devices and enables customers to apply their own power savings. HP offers a lifetime

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**Figure 4**

*This chart illustrates Watts/Gb, on different size frames and compares the HP ProCurve 5406zl switch to the Industry Average. The HP ProCurve 5406zl switch utilizes between 57-60% less Watts/Gb vs. Industry Average.*
warranty program, minimizing landfill by utilizing product replacement, refresh, and redeployment. HP recycles their own products as well as products from other vendors, thereby protecting the environment. HP recycled 1 billion pounds of material globally by 2007.

HP plans to reduce the power consumption of their operations, by 20% of 2005 power consumption, by year 2010. With an aggressive trade-in program, the HP product line is environmentally sustainable, generating less waste in the event of the reconfiguration or replacement of their products. In promoting standards and improving efficiency, HP has consolidated 83 data centers to 6 data centers.

Through version 2.3 of PCM+, remote network management is administered from a single point of access. With the capability to support up to 2,000 devices, PCM+ provides a cost effective telecommuting solution by offering remote management of multiple devices. PCM is event driven and allows administration of wattage allocation per port.

HP’s products are designed to improve energy efficiency for business operations, causing lower power usage during inactivity and greater power savings. As green features are implemented in the software, this capability can be utilized in the hardware. The current hardware also supports the green features by using low-power functionality during remote network management and administration.

A smart design, which allows for upgrades with minimal impact on resources, is the right way to proceed for future products. From a design standpoint, it’s easy to upgrade the technology which contributes to the lifespan of the product.

The HP produces intelligent switches designed for reuse and redeployment to meet expanding business needs. Users can effectively reduce the energy consumption through “set” command supported in CLI and PCM.

HP is the founding sponsor of “Green Grid” and is dedicated to developing and promoting energy efficiency standards for data centers. HP participates in joint research and collaboration to shape public policy for recycling, energy consumption and climate change; defines user-centric models, develops standards, and promotes measurement methods and new technologies to improve performance.

Green Innovation

HP designs the ProCurve Switches with exceptional flexibility to allow for upgrading the switches and builds in additional features to future proof the family of switches. This well engineered focus supports HP’s offer of a lifetime warranty, assurance of product longevity by reducing e-waste and service costs and extending the useful life of networking investments. In the unlikely event the product cannot be redeployed, the innovative HP product design allows product components to be effectively recycled. HP engineers products with features to save power consumption for their customers. In addition, by employing the HP solution, businesses are better equipped in the global market, exceeding the standards of RoHS (Restriction of Hazardous Substances).

HP has installed specific components on the ProCurve 5406zl switch that allow higher internal temperatures which will reduce the cooling requirements for the switches. The chassis is capable of supporting up to 131°F or 55 °C. By designing the ProCurve 5406zl switch to operate at higher temperatures, energy (cooling) and customer savings are realized.

Affiliations and Standards

HP is an active member of Energy Efficient Ethernet and driving the standards for a more energy efficient design and development. HP is the founding sponsor and member of Green Grid. HP is a strong proponent of standards based design, utilizing standards based Link Layer Discovery Protocol (LLDP), supporting dynamic power allocation, resulting in increased energy efficiency.

HP products are compliant with RoHS and exceed the international standards. These affiliations mentioned help HP to innovate based on “standards based design” and point to the credibility HP products and solutions have in the
Business Case

In Figure 1, there is an annual savings of $173 compared to other vendor switches tested and included in the Industry Average, realizing a cost savings of 45%, based on a Kw/hr cost analysis. The HP ProCurve 5406zl switch annual running cost was compared to typical switch utilization at a range varying from idle-state to the maximum line rate. The annual usage is based on the switch being used 16 hours per day each week. Idle time is considered weekends, holidays and the remaining 8 hours per day/week.

Using this scenario, a switch typically would be running at about 70% of capacity for 40% of the year. Maximum usage of 100% line rate would equate to a 10% annual usage. The remaining 50% of the year represents the switch being at near idle or steady state.

The Lifetime Warranty is an excellent example of HP’s commitment to the environment. By producing products that are designed to last for a long time, HP not only saves customers on warranty costs but also minimizes product disposal costs and ensures fewer landfills.

HP’s Green Business Technology initiative ties in with their “Adaptive Network Vision”, which is based on developing network application and solutions that can adapt to the changing business needs. Strong product innovation, coupled with the business benefits of Lifetime Warranty, free firmware updates and standards based design helps customers to choose from the best available options in the market, making HP ProCurve a leading networking vendor.

Certification for Green

Miercom conducts environmental analysis on products using holistic view, considering power efficiency and manufacturing. Power consumption and power efficiency are very important metrics for comparing products and are typically all that are discussed in other organizations’ green reports. We believe a more comprehensive approach, which reveals true business case savings to customers for the other environmental benefits a vendor’s product may afford, is a better approach.

Competitive index with industry average is achieved by comparing measured results from products in a given class. The significance of this comparison is that it allows a single view to annual cost for power consumption of a product, and comparison information that will help the consumer understand if the evaluated product affords an overall advantage for power efficiency.

Vendors with competing products that we considered in this review include Extreme Networks, Foundry Networks, Juniper, Cisco Systems and other manufacturers.
Miercom Certified Green

The energy-saving attributes of the HP ProCurve 5406zl switch was evaluated by Miercom in accordance with the Certified Green Testing Methodology. The product achieved sufficient scores in each of the rated criteria to achieve the Miercom Certified Green distinction Award.

Based on our hands-on testing and the verified representations made by HP ProCurve, Miercom confirms that the HP ProCurve 5406zl switch is designed to provide enterprise customers effective and environmentally sound networking and datacenter solutions.

About Miercom’s Product Testing Services

Hundreds of product-comparison analyses have been published over the years in such leading network trade periodicals as Network World, Business Communications Review - NoJitter, Communications News, xchange, Internet Telephony and other leading publications. Miercom’s reputation as the leading, independent product test center is unquestioned.

Miercom’s private test services include competitive product analyses, as well as individual product evaluations. Miercom features comprehensive certification and test programs including: Certified Interoperable, Certified Reliable, Certified Secure and Certified Green. Products may also be evaluated under the NetWORKS As Advertised program, the industry’s most thorough and trusted assessment for product usability and performance.