

A Smart Systems Approach to Enterprise Power

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As communication paths move from a real-time media environment to a demand-driven IP packet-based environment, a tremendous opportunity is emerging for energy-efficient infrastructure equipment for the data center.

Data centers consumed about 60 billion kWh in 2006, while the cost to power and cool servers worldwide surpassed \$26 billion. As this sum grows at four times the rate of server spending, information-technology professionals must consider the total cost of ownership of the data center in their purchasing decisions of infrastructure equipment. The cost to operate such equipment over its lifetime is now about three times greater than the cost to purchase the original hardware, according to the Environmental Protection Agency. Consequently, aggressive targets to cut energy consumption have been set by technology solutions providers.

Measuring performance of the data center by throughput (millions of instructions per second, or MIPS) or performance density (MIPS/ft²) alone is no longer sufficient. The key metric moving forward is performance efficiency (MIPS/W). Leading data center equipment providers have set goals to increase MIPS/W by a factor of 10 by 2010, while reducing overall power consumption by 20%. The winners will be those who successfully execute strategies to decouple MIPS from watts, allowing more processing power to be crammed into smaller enclosures to reduce electricity and building infrastructure costs.

Servers and the infrastructure to cool and protect them are the main sources of data center power consumption. The energy usage from each is about equal, and they are directly related. Therefore, for every dollar saved in server energy consumption, an additional dollar can be saved in infrastructure energy costs. Electronic loads consume 60% to 70% of server energy, power supplies consume 25% to 30% and cooling consumes 5%. While there is significant advancement in reducing the load's power profile, much can be gained by a holistic approach to system power management to reduce all three factors significantly.

New smart power-management system solutions involve the co-design of critical components of the power supplies integrated into the platform strategy. Key elements include highly efficient and dense power stages; advanced responsive power controllers; digital interfaces for programmability and diagnostics; accurate power monitors; system controllers; and sequencing.

Advanced power stages reduce power loss in power supplies by up to one-third compared to traditional designs. New products take

advantage of industry-leading MOSFET technology and advanced packaging. Optimized drivers co-designed with these MOSFETs deliver benchmark efficiency over heavy and light loads to eliminate up to 6% of server power loss with increased density over time.

Advanced power systems have an even greater impact on the power dissipation of the load. High power loads in the system, such as microprocessors, have a very unpredictable power profile due to rapid changes in required performance and function. Under severe requirements, these loads can exceed their thermal limits and require thermal throttling to allow the silicon and package to cool before starting back up. This stop-start thermal and power cycle is an enormous waste of energy and performance.

A holistic approach to system power management eliminates thermal throttling. By dynamically monitoring instantaneous power, recording its trends over time and understanding the thermal impedance of the load, the power system can accurately predict thermals in the system at any point. The power system can then alter the load's electrical characteristics to limit its power and establish the correct cooling conditions in advance through energy-efficient variable-speed motion control. This can eliminate up to 20% of server total power dissipation.

By using advanced power stages, accurate and dynamic power monitoring, and high-performance power controllers, optimized power-management systems can save up to 25% of server and data center power dissipation over the next three years, allowing data center equipment vendors to meet their performance objectives and enable a new generation of high-performance, cost-effective products that meet the insatiable needs of an ever-changing media environment.

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