

Green Computing : Creating Efficiencies through Datacenter Energy

D. Bairat*

* Nerac, Inc.

Tolland, CT, USA, dbairat@nerac.com

ABSTRACT

Data centers are major power consumers, a fact that is of particular concern in a climate of global economic instability accompanied by wildly fluctuating energy costs. As companies continue to review cost-cutting measures, datacenters, which are estimated to account for \$7.2 billion annually in energy expenditures, will only increase their impact on the bottom line with power consumption expected to grow by 12% annually. This presentation will examine how companies can advance energy –efficient data centers through new virtualization technologies and through partnerships with utility providers to deploy DC power supplies or alternate renewable power sources.

Keywords: data center, virtualization, green, power, energy

1 DATA CENTERS AND POWERUSAGE

Today the top concern in IT Industry is the power usage by data centers. The major concerns are power, cooling, availability and redundancy [1]. A typical new data center in the United States today has 1,000 racks, occupies 30,000 square feet, and requires 10 Million Watts (MW) of power to support the computing infrastructure. Projections for future data centers suggest even greater power consumption. Future 100,000-square-foot data centers could require 50 MW for the computing infrastructure and an additional 20 MW for cooling. Power for such a data center would cost nearly \$44 million a year (at \$0.10 per kilowatt-hour) for services and \$18 million annually for cooling.

2 DEMAND FOR DATA CENTER

Despite the recent global economic downturn throughout the world's developed countries, the worldwide data server market is forecast to continue its steady growth. According to IDC (International Data Corporation, a subsidiary of the International Data Group), factory revenue in the worldwide server market grew to \$13 billion in the first quarter of 2008, an increase of 3.5 percent over the same period in 2007 [2]. This represents the eighth consecutive quarter of revenue growth and the highest first quarter revenue in the server

market since 2001. The increasing demand for data centers is demonstrated by the fact that companies worldwide expect to continue expanding operations, as can be seen in Table 1.

Country	Percentage of companies reporting expected data center operation expansion in that country
UK	51
France	30
Germany	30
USA	16
Japan	14
Ireland	12
Netherlands	11
China	8
India	8
Singapore	2

Table 1: Data center expansion plans by country [Source: Digital Realty Trust Survey, 2007]

The table shows that the companies expanding their data center operations is seen highest in UK with 51 percent, followed by France and Germany with 30 percent .

3 TRENDS IN DATA CENTER

The trends toward increasing server density are resulting in higher power consumption in many data centers. Power densities in various data center have grown significantly in recent years and are expected to grow in the future. Consequently, power and cooling capacity are the primary constraints to expansion of computational capacity within a data center. As a result, data center managers must either invest in upgrading the power and cooling infrastructures of existing data centers or build new facilities. Either choice requires significant capital investment. All of this growth and expansion activity is significant when compared to the

economic pressure being encountered by most industries and companies.

Several key trends are driving the need for increased data services [3]:

- Move toward electronic record-keeping in the healthcare industry
- Increases in global networked manufacturing organizations
- Continued expansion of electronic banking
- Improvements in digital financial services transactions
- Growth of insurance databases
- Continued retail industry reliance on real-time inventories and supply chain management
- Record-keeping in transportation resulting from GPS navigation and RFID tracking

4 VIRTUALIZATION

Virtualization is a key emerging technology for creating less power-hungry data centers. In the virtual operating system, the software is used to allow a piece of hardware to run multiple operating system images at the same time. It can reduce data center power consumption by 14 percent while meeting IT demand with fewer power-hungry servers and storage devices, as well as helping reduce emissions [4]. Electrical power used for traditional data centers has generally been from natural gas, nuclear and coal. When power is produced there are also harmful emissions of green gas. Reducing the number of servers in a data center can reduce the emissions of harmful gases.

According to Network World reports, published in January 2009, HP commissioned a survey of 600 technology decision-makers in the corporate world; to find out their plans for their data centers in the coming year [5]. Approximately 60 percent reported that they will implement a green IT project in the coming year, and most expect to be doing a virtualization project.

5 GREEN POWER

The voluntary Green Power Partnership offers a solution to energy inefficiency by supporting organizational procurement of green power through expert advice, technical support, tools, and resources. Green power is electricity produced from a subset of renewable resources, such as solar, wind, geothermal, low-impact biomass, and low-impact hydro. Buying green power is one of the easiest and most effective ways to improve an organization's environmental performance.

According to the EPA, the Green Power partnership program has resulted in 57 of the Fortune 500 American

companies partnering with Green Power providers such as Biogas, Solar, Wind, Biomass, Small hydro, geothermal and various other resources [6]. Such partnership will undoubtedly lead to additional green data centers.

Future data centers can obtain more green power by using renewable energy resources in addition to virtualization. Existing data centers can reduce their costs and carbon footprints by changing their energy-buying habits. Solar electricity panels are being used on data center rooftops. Some data centers are adding electricity-generating windmills to their campuses to supplement increasingly expensive utility power. Others are taking advantage of geothermal energy resources. A few employ flywheels to store energy during off-peak hours and make it available when it's most needed. Biodiesel is also growing in popularity as a backup generator fuel.

6 PARTNERSHIPS BETWEEN IT INDUSTRY AND UTILITY COMPANIES

The partnership trend has been seen between IT Industry and Utility companies to build energy efficient data centers such as:

6.1 IBM partnership with Schneider Electric and APC

The partnership enables clients to quickly design and build a data center in nearly any working environment using IBM Global Services' capabilities and a standardized data center architecture, reducing upfront costs and reducing human error in the operations of the site. By combining IBM technologies with those of APC and Schneider Electric, IBM has constructed complete IT, power and cooling infrastructure solutions for small, medium, or large data centers [7].

6.2 SprayCool's partnership with Avista

SprayCool's technology uses a liquid, which is safe for electronics and people, to cool electronics and capture heat at the chip level before it reaches the air in the room [8]. Using SprayCool solutions to cool the servers in a conventional data center can reduce total cooling power consumption by 40 percent. Spray Cool has partnered with Avista, a utility company to provide even more savings. Avista also rewards customers for installing SprayCool-enabled servers.

6.3 IT Companies and Pacific Gas & Electric

The world's first Web 2.0 technology research and advisory community has announced Conserve IT, a new service designed to assist IT companies and their customers to qualify for rewards offered by Pacific Gas & Electric Company (PG&E) for installing energy-efficient equipment [9]. Seven storage suppliers have signed on for Wikibon's Conserve IT and have achieved, or are actively seeking qualification of their technologies with PG&E and other utilities. Companies committed to validating the energy efficiency of their storage platforms include 3PAR, Compellent, DataDirect Networks, EMC, Hitachi Data Systems, Nexsan and Xiotech.

7 ALTERNATIVE TECHNIQUES/ APPROACH FOR ENERGY EFFICIENT DATACENTERS

Alternate techniques that have been used and are being implemented for energy efficient datacenters other than virtualization and renewable energy sources are:

7.1 DC Power Supply

Ultimately, server boards use DC power through a DC/DC multi-output switcher or DC/DC converters. Therefore, the most efficient solution might be supplying DC power directly to the server, reducing energy consumption. This direct application of DC power will improve existing energy consumption. In order to supply the power required by a 300W server, 973W of power is required. The most natural DC option would be 48V DC as the -48V DC enclosure market is used in wireless, traffic control, comdata, utilities, access control, and public security. 48V DC is the standard for the telecom industry, and thus widely compatible [10]. But in very large data centers with centralized distribution systems, 48V DC will have higher cable and/or bus bar costs associated with high currents and long runs

The typical large data center AC power distribution system is very complex and costly. Because of the reliability requirements of these facilities there are many redundancies, power conversions, paralleling controls, static transfer switches and bypass connections built into the system. A key question is determining what the distribution voltage should be: 500V DC; 380V DC; or 48V DC. Existing Sun power supplies can be changed out to run on 380V DC. The straight-48 scenario requires very large wire diameters, so is probably not appropriate. In most cases 380V DC power supplies inside the server's telecom installations have been using 48V DC systems successfully and with great reliability for years.

7.2 Energy efficient UPS system

The use of energy-efficient UPS (uninterruptible power supply) reduces the consumption of electricity, which lowers energy costs for the end user while having a positive impact on the environment. Though the cost of energy efficient UPS is more than the traditional UPS, over the long run the benefits make it worth considering. With more awareness on the benefits of the energy efficient data centers and advancement in technology, the cost factor can be justified [11].

7.3 Disk based approach

PowerFile's unique approach of dynamically caching the most frequently accessed data and preserving archives in a virtualized, massive array of Blu-ray media, allows the A3 Enterprise Edition to provide the online accessibility of disk-based alternatives while consuming less than 5 percent of the power [12].

7.4 Storage virtualization manager

LSI Corporation recently announced the latest release of its LSI StoreAge(TM) SVM(TM) (Storage Virtualization Manager) software suite, an advanced services platform that enables centralized storage management and multi-level data protection for distributed, heterogeneous storage environments [13]. The software also delivers green benefits by allowing storage platform consolidation, which reduces data center power consumption for improved energy efficiency.

7.5 Tape based solution for mid-size data center

A sponsored white paper, written by David Reine and Mike Kahn of The Clipper Group; looks at the total costs of ownership over a five year period for the long-term storage of data in tiered disk-to-disk-to-tape versus disk-to-disk-to-disk solutions[14]. The total cost of ownership of SATA disk archiving solutions is approximately 23 times that of tape-based archive solutions. Tape is the more energy efficient choice for the data center, providing up to a 290:1 advantage on energy costs. Tape is also the more economical solution for long-term storage requirements for mid-sized data centers [15].

7.6 Blade server systems by HP

HP's blade server technology can help achieve energy efficient data centers with a cost effective solution for Enterprise data centers and Small/Mid- sized business and enterprises, both for remote and branch sites [16]. HP and

IDC have come up with the blade server cost model for hardware and software which uses pricing and capabilities for a new product that has just reached the marketplace. In general, implementing blade architecture can reduce capital expenses associated with the hardware and software components, approximately by 36 percent [17].

7.7 EMC and VMware data center efficiency solution

EMC and VMware jointly provide hardware and software support to organizations to assess server and storage utilization to build green data centers. EMC provides consulting in green IT, assessing data centers' energy efficiency. The partnership provides virtualization solutions to consolidate servers by a 20:1 ratio, increasing capacity utilization and eliminating unnecessary infrastructure [18].

CONCLUSION

With more data centers coming on line in the future, it becomes increasingly critical to find energy efficient, cost-effective ways to power them through partnerships and by applying new technologies. We believe virtualization now offers the best promise for cost savings with reduced space requirements and improved energy efficiency. The technologies and their applications are evolving rapidly, making it vitally important for decision-makers to have a broad, detailed, and up-to-date grasp of their options for their data center needs.

REFERENCES

[1] Needle, David., "HP's Green Data Center Portfolio Keeps Growing." 2007.
[2] Robb, Drew., "Recession, What Recession?" 2008.
[3] U.S. Environmental Protection Agency., "Report to Congress on Server and Data Center Energy Efficiency." 2007.
[4] Serpo, Alex., "Virtualization: The key to a green data center?" 2008.
[5] Gralla, Preston., "HP Study: Green Data Center Is Key Concern of IT Pros." 2009.
[6] EPA., "Fortune 500 challenge." 2009.
[7] Schneider Electric., "Schneider Electric partners with IBM to bring Eergy Efficient Data centers." 2007.
[8] Monahan, Paul and Fish, Autumn., "Spray cool - Mountain Gear Climbs New Heights, Chooses SprayCool to solve its Data Center's Power and Cooling Issues." 2007.
[9] Butler, David., "Storage Customers Seeing Green with Wikibon's Conserve IT." 2008.
[10] Ton, My, Fortenbery, Brian and Tschudi, William., "DC Power for Improved Data Center Efficiency." 2008.

[11] Frost and Sullivan., "Savings in Energy Costs and Environment-friendly Profile Motivate Demand for Energy-efficient UPS." 2008.
[12] Buckley, Jonathan., "PowerFile Sets Standard for Archive Storage Density, Scalability and Energy Efficiency with New Active Archive Appliance Enterprise Edition." 2007.
[13] LSI., "Storage Networking World." 2008.
[14] Kahn, Mike and Reine, David., "Disk and Tape Square Off Again —Tape Remains King of the Hill with LTO-4." 2008.
[15] Hughes, Jim., "Clipper Group Reports Substantial Cost Advantages of Using Tape in Tiered Storage Approaches." 2008.
[16] HP., "HP BladeSystem c-Class portfolio." 2009.
[17] Kelly, Quinn, Fleischer, Daniel, Scaramella, Jed and Humphreys, John., "Forecasting Total Cost of Ownership for Initial Deployments of Server Blades." 2006.
[18] EMC., "Information Infrastructure for VMware." 2009.