Independent Auditing for Virtual Server Consolidation

A Sustainability Services White Paper

By
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What's in this White Paper?

INTRODUCTION

The Need for Green Computing

The increasing reliance on digital data in our society is driving a rapid increase in the number and size of data centers. This growth is the result of several factors, including growth in the use of internet media and communications, ongoing digital conversion of business applications, establishment of new regulations that require retention of digital records, and requirements related to disaster recovery. Unfortunately, this growth has contributed to Information Technology (IT) becoming a significant contributor to rising energy consumption among businesses.

A typical data center facility spends almost half of its energy consumption on the systems powering and cooling the computers inside - not on the computers themselves. The introduction of more efficient CPUs based on chip multiprocessing has contributed positively toward more energy-efficient servers. However, even an energy-efficient server still consumes about half its full power when doing virtually no work. In 2007 the EPA Report to Congress on Server and Data Center Energy Efficiency was published in response to U.S. Congress Public Law 109-431. The report confirmed the rapid growth and energy consumption of data centers and generated new interest in ***Green Computing*** - the study and practice of using computing resources efficiently.

The world's data centers are projected to surpass the airline industry as a greenhouse gas polluter by 2020, according to a new study by McKinsey & Co. Over that time, the carbon dioxide emissions attributable to the electricity consumed by fast expanding data centers will rise fourfold, the study estimates.

The cost of electrical energy in the U.S. is rising at an annualized rate of 11 percent, most of this feeding fossil-fuel generation. Data centers are projected to consume 2.3 percent of total electricity production in the U.S. by 2010.

Fortune 1000 companies face pressure to deliver new business applications and services at an ever increasing pace in the face of rising power and cooling costs. These applications and servers often require new hardware that utilizes additional rack spaces, thereby gobbling up precious floor space. Over the past decade the cost of power and cooling has increased 400% and is expected to continue to rise. In some cases a data center's electric bill may consume 40% to 50% of its operating cost. As a result, data center consolidation has rapidly emerged as the number one priority for many IT managers. New technologies such as *virtualization* – the replacement of physical servers with 'virtual' (software) servers- are being employed to help. *Server Virtualization* brings the potential to deliver cost effective implementation of disaster recovery (DR), high availability servers (HA) and dramatic savings in terms of server count, footprint, power consumption and cooling requirements.

Note: There are many types of virtualization technologies available on the market today (VM ware, Citrix, Microsoft, etc.). The description and implementation of these technologies is beyond the scope of this white paper. The reader may refer to the reference section for sources on this topic.

Zuma Engineering and Research is joining the Green Computing movement by providing independent auditing of Information Technology (IT) data centers to assist with optimizing performance and reducing their environmental impact and overall carbon footprint.

THE VALUE OF INDEPENDENT AUDITING

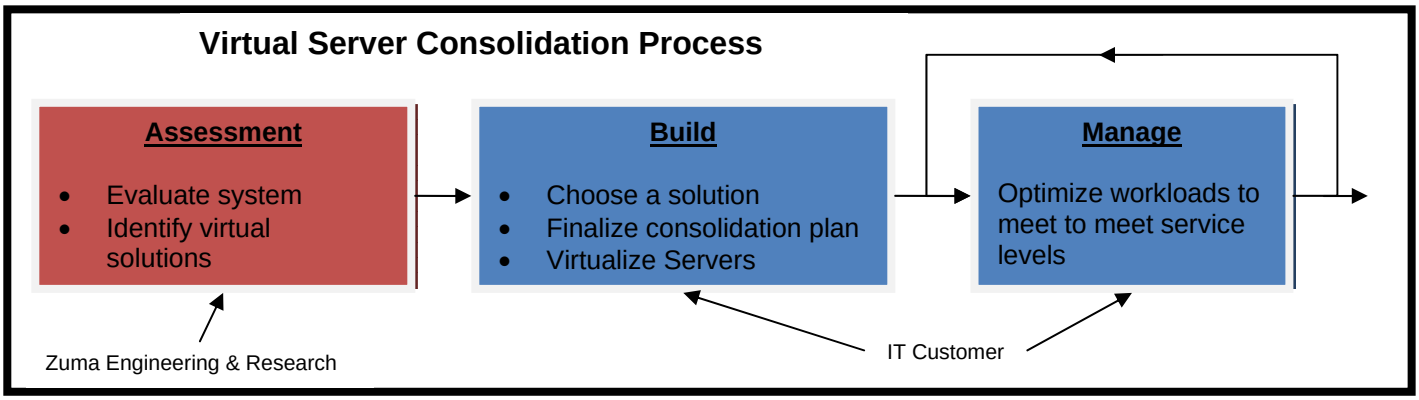
The "greening" of the data center introduces a new dimension into server consolidation and virtualization; that is, the need to factor in server power consumption and cooling requirements when planning, implementing, and managing the consolidated, virtualized environment. IT administrators must ensure that the resulting server configuration reduces power consumption, can handle current workloads at agreed-upon service levels and provide sufficient room for growth. They often have a difficult time understanding what it takes to properly set up a functioning virtual server infrastructure in a real world data center. It is also difficult for them to identify opportunities for energy and cost savings, without an accurate view of their infrastructure (including applications) and a sense of how that infrastructure relates to the delivery of business services. Industry consortia, as well as many private enterprises, are working diligently toward education of data center professionals and providing services to supplement their own staffs to meet these challenges. Many companies are investing in building their internal expertise by cross-training their IT staffs in electrical power and cooling systems. What is emerging is a professional specialty in IT facilities, delivering both new business applications and services at an ever increasing pace***. Zuma Engineering and Research*** fits into this new business area by providing independent auditing services in support of data center optimization.

Why is an independent Auditor Important?

Issue	Description	Independent Auditor Benefit
No Organizational Conflicts	• Champions of Virtualization must overcome cultural resistance to sharing systems across different groups within an organization. • Users must not feel constrained. Application and data security; system availability and workload impacts must be minimized to acceptable levels. • Many internal political problems are related to departmental loss of control and lack of available IT	• Project stakeholders will be supportive when reassured an independent auditor will have the time to perform due diligence with respect to applications they own, their dependencies to elements of infrastructure and other applications. • An independent auditor has no organizational conflict of interests (OCI). • An independent auditor augments existing or adds lacking personnel needed and works directly with the department to assess their current system and future needs. • Audit results are useful for gaining the attention of financial managers and other supervisors in an organization that might not otherwise be concerned about a facility's energy consumption.
No Vendor conflict of interests	• Vendors have confused the marketplace by introducing 'free' virtualization surrounded by claims that they are cost leaders, while focusing little attention on performance and management. • Vendor assessments tend to provide their "virtualization made easy" products that may only shift existing costs and operational complexity from the physical world to the virtual, without realizing the agility and business resilience you seek.	• An independent auditor will sort out the confusion and provide an unbiased assessment of the customer needs. • We won't choose the "newest" or cheapest" solution just because they are new and inexpensive. • We will look for a solution that has been around for a long period of time to ensure the technology has been tested with a variety of applications • We will offer proven solutions that offer flexibility and options to fit the needs of your company.

PHASES OF A SUCCESSFUL CONSOLIDATION INITIATIVE

Successful virtual server consolidation initiatives require careful planning and a thorough understanding of the server workloads that need to be consolidated. Server consolidation is typically completed in phases (Assessment, Build and Manage) which consist of discreet steps. ***Zuma Engineering and Research*** proposes to perform the assessment phase of the consolidation process as an audit service (see diagram below). It will then be the responsibility of each customer to complete the remaining phases - Build and Manage – which require choosing and implementing the optimization solution(s).



Assessment Phase

Step 1 – Determine System Configuration and Power Consumption
The first step in planning a server or data center consolidation is to acquire actionable data by determining the current system configuration (servers, cooling, floor spacing, etc.) and power consumption to create a thorough inventory of all server assets.

Step 2 – Analyze Workloads
Generate a hardware utilization report that identifies workload and resource mismatches such as under-utilized or over-utilized servers. The workload profile, which combines inventory and utilization metrics, provides a much deeper understanding of workloads. When combined with business service requirements, the workload profile enables increased visibility into data center operations and allows managers and architects to effectively plan for current and future consolidation initiatives.

Step 3 – Evaluate Solutions
Armed with a detailed profile of workloads in the data center and analysis of real-time utilization data we will evaluate virtual solutions with different combinations of hardware and virtual hosts. Tactical solutions that make the existing system efficient will also be evaluated in this step. These include, but are not limited to enabling server processor power saving features; powering down servers when not in use; and removing old systems that provide no useful work. In addition, we will quantify the cost, physical space, and power savings for each solution. The customer will be provided with a final report that can be used as a starting point for a consolidation plan and/or a Total Cost of Ownership (TCO) trade study.

VIRTUAL SERVER CONSOLIDATION BENEFITS

This section highlights key benefits associated with virtualization. Each system is unique and may or may not reap benefits in each topic discussed in this section.

Financial Benefits

Virtual machines are a key enabling technology that can be leveraged to achieve financial business benefits.

Virtualization reduces the need for costly servers and delivers compelling cost savings. Virtualizing on a moderate scale, the average company can save $8,251 per workload over three years. That means they can save $825,100 per 100 workloads virtualized, or $8,251,000 per 1,000 workloads virtualized. [Virtualization: Architectural Considerations And Other Evaluation Criteria', VMWare Inc. 2005]

Smaller Energy Footprint Reduces Energy Bills

- Reduces number of servers through consolidation and elimination
- Reduces cooling equipment (HVAC, fans, water cooling systems,etc.)

Reduces IT Admin Costs

- Optimizes and reduces IT admin costs
- Assists with controlling IT management costs

Reduces IT Equipment Costs

- Reduces duplicate hardware or software required to meet DR (Disaster recovery) requirements
- costly servers and racks eliminated with consolidation
  Reduced power reduces cooling equipment (fans, racks, HVACs) needs

Incentives & Grants may be Available

- State, Federal or local energy tax credits or deductions
- Special Project Funding
- American Recovery and Reinvestment Act of 2009
- Federal Small Business Innovative Research (SBIR)
- Federal Small Business Technology Transfer (STTR)

The typical return on investment (ROI) period for a virtualization project is six months or less—so most virtualization projects quickly pay for themselves [A Guide to Bottom-Line Benefits, VMware inc. 2008]

Below is a typical small company, running 240 applications, one application per server, each server operating at about 10 to 15 percent CPU utilization. In a typical scenario, about 200 or more of these applications would be candidates for virtualization, at an average rate of four applications per server. Consolidation would trim the configuration down to 52 physical servers in a virtualized environment and 30 conventional servers each running a single application, for a total of 82 hardware boxes. The noticeable savings are shown in the table below:

The ROI of virtualization	Before Virtualization	After Virtualization
Data center size	240 servers	82 servers
Server power draws	240 @ 200W	30 @ 200W, 52 @ 270W
Total power required	48 kW	20.04 kW
Cooling	13.6 tons	5.7 tons
UPS/electrical loss	7.2 kW	3.0 kW
Electrical cost	$.08 per kWhr	$.08 per kWhr
Yearly electrical costs (IT only)	$33,638.40	$14,016.00
Additional costs (UPS/electrical)	$5,045.76	$2,102.40
Additional costs (cooling)	$27,078.91	$11,282.88
Total yearly electrical spend	$65,763.07	$27,401.28
Total savings per year		**$38,361.79**
Power improvement		**58 percent**
Reduction in cooling		**7.9 tons**
Reduction in UPS/electrical loss		**4.194 kW**

Source: Is your data center ready for virtualization? *Important power considerations for virtualized IT environments By Chris Loeffler, Global Applications Manager, Distributed Power Solutions, Eaton Corporation*

VIRTUAL SERVER CONSOLIDATION BENEFITS CONTINUED

Data Center Management Benefits

Server virtualization has enabled enterprises to harness the growing power of inexpensive computers and put a higher percentage of purchased capacity to use.

"It is reasonable to assume that virtualization will improve server use from an average of from 10% to 20% for x86 machines to at least 0% to 60% during the next three to five years. This should indicate a need for fewer servers." [Gartner, Inc., "Important Power, Cooling and Green IT Concerns", by Rakesh Kumar, Jan 23, 2007]

Reduces Physical Space

- May help eliminate or postpone need to expand data center
- Reduction in servers, racks and cooling equipment helps save valuable floor space
- Improves productivity as IT demands grow without increasing hardware

Scalable and Adaptable Solution

- Adds automation and policy based management capabilities
- Automates the management of energy efficiency in your data center
- Automates the process of continuous server consolidation
- Extends the life of datacenters by allowing continuous server consolidation to meet resource requirement change

"A large European data center is said to have converted a significant portion of its physical server environment to virtual and reduced its server requirements for those applications from 250 server to 18" – [Making Green IT a Reality, by Oliver Wyman, December 2007]

System Reliability Benefits

Equipment failure or a site disaster could have a devastating effect on business processes, revenue, and corporate reputation. Virtualization can help mitigate risk and increase reliability.

Increased System Reliability

- Reduces physical equipment growth to yield increased reliability (HVACs, water cooling systems, etc.)
- Cost effective price and easier implementation for DR (Disaster recovery)
- Reduces computer complexity to yield increased reliability

VIRTUAL SERVER CONSOLIDATION BENEFITS CONTINUED

Computing Benefits

Virtual servers are scalable and adaptable which increases computing flexibility.
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Virtual Servers Increase Computing Flexibility

- Enables efficient use of computer resources
- Enables customers to run multiple operating systems concurrently on a single physical server, where each of the operating systems runs as a self-contained computer
- Data center administrators can regularly monitor profile and assess workloads to identify resource mismatches
- Capacity issues can be forecasted and proactively addressed
- Supports continuous server consolidation as utilization rates increase
- Creates HA (high availability) computing by shifting resources as needed

Environmental Compliance Benefits

Increased penalties are looming for data centers that do not reduce their energy footprints to meet environmental compliance requirements. The EPA has already recommended charging data center tenants for energy consumption of IT equipment in government-owned data centers and local electric bills are rising for commercial data centers.

Server Virtualization is Green Computing

- Reduces energy footprint
- Retiring old IT equipment containing dangerous substances helps meet RoHS (Restriction of Use of Hazardous Substances) regulations
- Assists with meeting Green Computing business management initiatives
- Results can be used to support EPA recommendations for research and development; data center Standardized performance measurements and public/private partnerships for energy efficiency in data centers

CONCLUSION

Organizations must begin to think differently about the data center. The environmental impacts and rising costs are becoming too great to ignore. The cost savings and environmental benefits of consolidation and virtualization are closely aligned. By consolidating servers into more energy-efficient virtual machines, organizations can retire old, power-hungry hardware and optimize underutilized servers to achieve significant savings in space, power and cooling requirements. There are many types of virtualization technologies and the lines are becoming blurred between the different types. When is it appropriate to use one type of technology? Is it beneficial to use two types of virtualization technologies together? A first step toward answering these key questions and avoiding consolidation complications is to have Zuma Engineering & Research perform an independent audit of your IT infrastructure. Our independent audit will:

- Create a view of how an organization's IT infrastructure relates to the delivery of business services
- Identify opportunities for energy and cost savings
- Help with generating a consolidation plan
- Provide an analysis of the products and projects being funded to ensure that their purchasing activities are based upon sound business and technical reasons

Please contact us for additional information regarding how we can help your company:

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Gary Wilson is the president and founder of *Zuma Engineering & Research* – a small company that provides engineering and management assistance to businesses specializing in advanced technologies. He held positions as a scientist, engineer, functional manager, program manager and corporate executive during his more than 20 years in the field of engineering. Mr. Wilson graduated from Dartmouth College with A.B. and B.E. degrees and has a M.S.E.E. degree from California State University Long Beach. He is an active member of IEEE, AFCEA, SAE, AIA and AIAA.

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