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Maximizing operational efficiency and minimizing carbon emissions with proactive energy management | February 2012

Five steps for increasing availability and reducing energy consumption and costs across cloud and virtual platforms

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executive summary

Challenge

Cloud computing has become synonymous with cost reduction, with energy and environmental benefits taking lesser credit. This, however, is changing. As energy and environmental gains are becoming more closely linked to financial savings, cloud computing is being seen as a champion in all three areas. To make the right cloud choices and optimize existing public and private platforms, organizations need to understand the energy overhead associated with different IT workloads and devices. Gathering timely and consistent energy consumption data from various physical and logical entities is always a huge challenge in traditional data centers as well as cloud-enabled environments. To remove inefficiency and the risk of inaccurate information, companies need to move away from manual and decentralized approaches.

Opportunity

Real-time monitoring, automated processes and centralized data collation can provide organizations with accurate insight into energy consumption and efficiency within the data center. As a result, organizations can make informed decisions about how to leverage private and cloud infrastructures and optimize power usage effectiveness on an ongoing basis. Key decisions on cost and risk transference can also be made using this data and associated analytics.

Benefits

Proactive energy management can help organizations minimize the risk of data center downtime as well as reduce their power consumption and costs. This will result in a smaller carbon footprint and greater eco-competitiveness. With carbon reductions from cloud computing estimated to top 85 metric tons by 2020 (CDP 2011)[1], more and more organizations are intentionally rather than accidentally tapping into the environmental benefits of this latest IT model.

Section 1: Challenge

Exploiting the cloud's green lining

Cloud computing has enjoyed a fast and furious rise to fame. And unlike some IT trends, it's here to stay. The financial benefits of cloud computing have been much publicized, with one industry report citing that private cloud implementations can reduce costs by as much as 50 percent, according to recent research by the Carbon Disclosure Project (CDP).[1]

Although adoption was originally driven by the need to reduce the risk of power or cooling related outages and operational costs, cloud computing is also increasingly being seen as an energy and environmental champion.

As effective power management, cost reduction and service availability become inextricably linked, organizations need to ensure they consider all these factors when assessing how best to provision their IT in the short and long term, and how to optimize current and future cloud environments.

Energy inefficiencies fuel consumption

With power consumption rates growing by 20 percent a year, the data center is ripe with opportunities for improvements in energy management for end user organizations and IT service providers alike. Servers represent around 30 percent of the energy burn in the data center while cooling consumes another 25 percent.

Although virtualization minimizes the number of physical servers required to run enterprise applications, it also introduces the need for high-density racks where power and cooling requirements are also higher.

While overall data center consumption and costs will go down with virtualization, the risks to availability will go up as more servers will be running in a smaller area. If something goes wrong with power or cooling resulting in a failure, more servers—and business applications—will be impacted. However, there is a solution—intelligent alerting.

Establishing power consumption metrics

PUE has become the widely accepted standard for measuring how efficiently a data center uses power. It is calculated by comparing a facility's total power usage to the amount of power used by the IT equipment, revealing how much is used for non IT needs and also the losses in distribution and conversion. According to the Uptime Institute, the industry average is 1.8, although some cloud providers have reported PUEs of between 1.07 and 1.2[2].

In addition to PUE, many organizations will choose to define their own metrics, such as total transactions to power consumed or revenue generated to power consumed, which can help improve the efficiency of their overall business operations.

Device level metrics, such as the efficiency of a CRAC unit, the number of transactions per watt of power consumed by a server or a router can also be defined, monitored and managed to help optimize the energy consumption and leakage avoidance.

With so many devices contributing to the overall PUE, it can be hard for organizations to calculate this high-level metric as well as the overall cost of running different IT workloads—in terms of dollars and carbon emissions. Visibility of such key performance indicators (KPIs) are essential for:

- Operational cost and efficiency
- Complying with environmental legislation and carbon offsetting programs, such as the UK's CRC Energy Efficiency Scheme
- Meeting internal sustainability goals and reporting performance to stakeholders
- Cross-charging departments (or customers in the case of a managed service/cloud provider) for power consumption

Organizations also need access to these KPIs if they are to make an informed decision about whether to migrate a business service, such as email, to a private or public cloud. As Forrester Research, Inc., cites: "If you're implementing or considering cloud, you're likely collecting data to determine the extent of cost savings or increased speed-to-market. But if green IT is also a priority, be sure to measure energy use to track reductions in energy costs or carbon footprint, or point out out-of-power and -cooling issues in the data center."[3]

Power consumption and costs are not only key to cloud adoption benchmarking exercises but also for the on-going effectiveness of such models.

Complex processes result in flawed data

Collecting and measuring such data, however, poses a massive challenge for many organizations. Not only do they need to pull data from multiple IT and facilities end points but also execute complex calculations to determine energy usage for some devices.

For example, a server might consume 340 watts when active but 100 watts when idle, so the overall power consumption will depend on its utilization, which may be different during the day than it is at night. With cooling units, power consumption is just one part of the energy and environmental equation. Organizations also need to understand the heat being removed from the data center to make operational decisions.

Although organizations may be able to access some power consumption data via their building management systems or in-built power distribution units in data center racks, manual intervention is often required. For example, staff at IT services company Datotel had to take individual readings from different systems and manually enter them into spreadsheets (see case study on page 10).

This type of approach is not only time-consuming but also susceptible to human error, which can lead to inaccurate metrics being used for sustainability reporting, billing and important cloud migration decisions.

Section 2: Opportunity

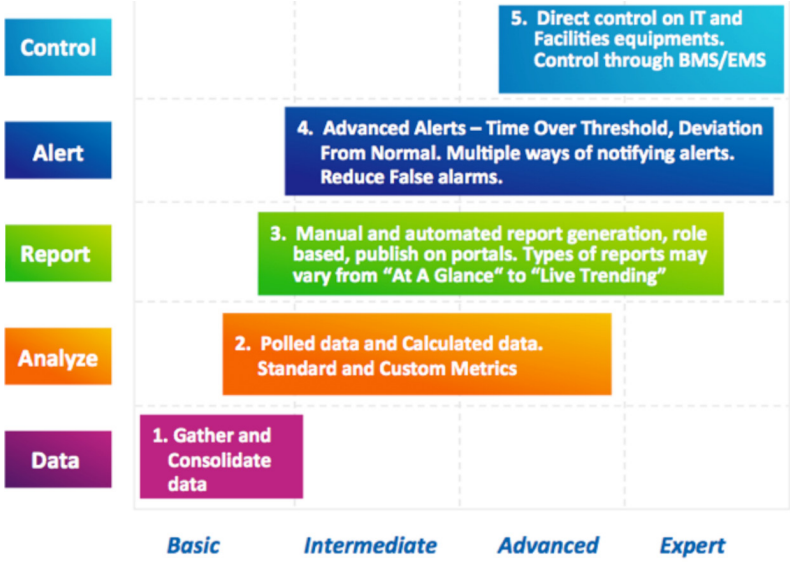
Enabling effective energy management through automated and real-time monitoring

To understand the environmental overhead of running IT workloads on cloud, virtual and non-virtual platforms, organizations need to transform their approach to monitoring and measuring energy usage.

There are five key steps to this transformation (see graphic), which, once completed, can take an organization to an expert level.

Figure A.

Five steps to achieving energy management excellence in a private or public cloud.



Step 1: Data collection and consolidation

Accuracy and automation are fundamental to the data capture process. If information is incorrect at the outset, then all metrics and decisions going forward are likely to be invalid. To eliminate erroneous data, organizations must eliminate manual processes.

Best of breed energy management solutions can automatically poll thousands of devices in real-time, thereby enabling organizations to build up a detailed map of power consumption across a data center as well as individual private or public cloud environments.

Data should be consolidated into a standard format and stored in a central repository to provide organizations with both a current and historical view of energy usage.

When selecting an energy management solution, it is important to ensure that it can support multiple system protocols (for example SNMP, Modbus, and BACnet) and can integrate with existing building management platforms.

Step 2: Advanced analysis and metric mapping

With a baseline established, organizations can start to analyze their performance in terms of energy efficiency. The complex calculations that contribute to measures, such as PUE, can also be automated through the use of an energy management solution.

Ideally the solution will provide a PUE and other metrics at every polling interval—whether it is 30 seconds or 30 minutes—to help identify peaks and troughs in energy usage throughout the day and night.

As well as calculating the PUE for specific facilities, organizations should consider including the following metrics as part of their energy and environmental monitoring framework:

- Data Center infrastructure Efficiency (DCiE)
- Site Infrastructure Energy Efficiency Ratio (SIEER) - an Uptime Institute metric
- IT Productivity per Embedded Watt (IT-PEW)
- Carbon Usage Effectiveness (CUE)
- Energy Reuse Effectiveness (ERE)

Forrester Research, Inc., also recommends that organizations "Use metrics and incentives to maximize the green IT benefits from facility, hardware, and software investments. Forrester advocates three broad types of green IT metrics: procurement, operational, and end-of-life. In the context of cloud-based infrastructure, emphasize operational metrics that are quickly evolving in the data center, with The Green Grid's Power Usage Effectiveness (PUE) the most prominent. From there, develop targets and goals based on your green IT metrics, and financially incentivize staff to meet them."[3]

In addition to providing visibility of past and present power consumption, some energy management solutions can help organizations run 'what if' scenarios to determine how changes to their data center or cloud infrastructure might increase—or decrease—energy efficiency.

Step 3: Reporting key environmental and energy performance indicators

A plethora of energy management metrics have little value unless they can be shared. Previously reporting such information to internal and external stakeholders required multiple spreadsheets and considerable manual effort. As a result, information would be days if not weeks out of date by the time it reached its audience.

By deploying an energy management solution, reporting can become both automated and real-time. Interactive dashboards can be used to provide different stakeholder groups with access to a range of reporting formats and content, for example at a glance KPIs or live trending.

Key reporting areas to consider both from a cloud and overall data center perspective include:

- Power consumption and costs
- Energy efficiency and utilization
- Greenhouse gas emissions

Over time these and other measures can provide stakeholders with the environmental insight they need to make decisions about how to best leverage private/public clouds or manage existing

'non-cloud' infrastructures. For example, if a peak in power usage is identified at one facility at month end, an organization might choose to transfer part of the IT workload to another facility that offers lower energy costs or higher energy efficiency.

The ability to respond to energy consumption conditions can be particularly valuable in public cloud environments where resources are often spread across multiple sites and geographies.

The reporting process and data accuracy are also fundamental to the cloud billing process—whether it involves a public provider and multiple end customers or a private environment used by several different departments or government organizations.

The granular information captured by energy management solutions can help organizations drill down to the power consumption and cost of a single rack in the data center, thereby ensuring greater accuracy and transparency.

Step 4: Alerts to abnormal power consumption levels

The metrics collated by an energy management solution can also be used to alert IT departments to potential problems across their cloud, virtual and non-virtual infrastructures.

By using historical polled data, organizations can establish a series of thresholds for 'normal' device, breaker or rack behavior in terms of power consumption. If this threshold is breached by a defined amount or for a defined length of time, then an automated alert can be issued via email or interactive dashboards.

An energy management solution's alerting and monitoring activities can also be integrated with other IT management and ticketing systems, thereby further simplifying on-going operations.

Visibility of power consumption deviances can help organizations identify system faults as well as energy hot spots, and take rapid remedial actions. For example if a server fails to consume the normal amount of energy during the nightly backup routine, this could indicate that the process did not execute correctly.

Step 5: Controlling workloads across multiple platforms

The final step towards energy management excellence is to use the polled data and thresholds to establish a series of triggers for the ongoing management of data center infrastructures—whether they are cloud based or otherwise. This approach also requires the implementation of automation tools that can seamlessly move IT workloads between different virtual machines based on certain scenarios.

By integrating these tools with an energy management solution, organizations can reschedule non-critical but resource-intensive workloads to geographies or timeframes that allow them to take advantage of lower prices per kilowatt.

As well as following this five-point plan, end user organizations also need to change their mindset towards cloud computing, so it is no longer seen as just a vehicle for cost and agility improvements. As Forrester confirms, "Although I&O [infrastructure and operations] professionals are adopting cloud-based infrastructure and green IT practices to meet financial and strategic objectives, these efforts are being pursued independently and opportunistically. Forrester recommends that IT I&O professionals marry the two strategies by embedding green IT practices into their cloud computing strategy, and vice versa."[3]

Section 3: Benefits

Reducing energy consumption, costs and carbon emissions

Implementing an automated energy management solution can help organizations unlock the environmental and financial benefits of cloud computing in a shorter timeframe by providing the metrics needed to make informed decisions about initial adoption and ongoing management.

With access to granular data on energy efficiency, consumption and costs, organizations can:

- Make proactive use of more cost-effective power sources based on geographies, IT workloads and timeframes
- Identify inefficient cooling or IT systems and retire or upgrade these devices
- Achieve PUE levels that match or exceed industry averages

These and other energy optimization strategies can result in a significant reduction in power consumption and carbon emissions as well as data center downtime. According to the Carbon Disclosure Project (CDP), by 2020 these reductions could equate to 85.7 million metric tons of CO_2 per year for US businesses with annual revenues of more than $1 billion[2] assuming they spend the predicted 69 percent of infrastructure, platform and software budgets on cloud services.

A lower carbon footprint is not only good news for the environment and climate change, it can also help organizations:

Deliver significant cost savings: The equation is simple: lower power consumption means lower power bills. Although the scope for savings depends on the extent of energy efficiency measures and cloud adoption undertaken by each organization, the industry is optimistic about the final outcome. According to the CDP, based on the forecast uptake of cloud computing, US businesses with annual revenues of more than $1 billion could achieve economy-wide savings in energy alone of $12.3 billion a year by 2020[2].

Boost their brand and reputation: Given the current concerns about climate change and environmental damage, demonstrating a reduction of energy consumption and carbon emissions can prove a key differentiator in terms of eco-competitiveness. For example a survey by an independent analyst firm found that 57 percent of respondents believe organizations achieving a leadership position in the CRC Energy Efficiency league table will be able to drive incremental sales by improving the organization's brand.

As the environmental and energy benefits of cloud computing become more widely recognized and realized, organizations will no longer be focused on just making business agility and financial gains. They will also want to proactively tap into the enormous energy efficiencies. As a result, cloud computing will soon become equally synonymous with helping to reduce carbon footprints around the world.

Section 4: Case study 1

StratITsphere enhances competitive advantage with proactive power management

StratITsphere helps organizations achieve a superior return on their technology investments by providing a range of IT infrastructure, data center and security consulting services.

To ensure it can deliver cost-effective and sustainable services, StratITsphere needs to minimize the energy overhead associated with its data centers.

Stephen Webster, President and Chief Executive Officer at StratITsphere, comments, "Energy is our most significant operational overhead; if we can minimize these costs then we can not only increase our profitability but also deliver more affordable services to our customers."

As well as meeting customers' financial expectations, StratITsphere increasingly needs to help organizations deliver on their environmental goals.

Although StratITsphere had been collecting selected energy data for some time, this approach was no longer viable—especially with the opening of its new Tier IV data center.

Tracking power consumption and costs in real-time

StratITsphere implemented CA ecoSoftware in March 2011. The solution is used to monitor power consumption for 12 customers at the company's Tier IV data center. It assembles data from a diverse collection of devices into a centralized repository for analysis, reporting and alerting.

The solution provides automated alerts to unusual conditions, such as excessive power consumption, which helps StratITsphere to optimize device configuration and identify possible faults with IT equipment that could impact availability.

"Granular and accurate energy data enables us to make intelligent decisions around power management that reduce consumption and costs both for us and our customers," comments Webster.

As well as the financial benefits, the solution has helped StratITsphere:

- Reduce carbon emissions
- Differentiate its cloud and data center services through transparent and accurate power billing
- Identify new revenue streams and potential for growth.

"With CA ecoSoftware we can offer pioneering power management services to our customers, which will not only help reduce costs but also help organizations to meet their sustainability goals in terms of energy efficiency and carbon emissions," comments Webster.

Section 5: Case study 2

Datotel minimizes power consumption and enhances competitive advantage with CA ecoSoftware

Datotel's launch in 2004 was marked with the opening of an $8 million IT co-location facility in St. Louis, Missouri in the US. This 35,000 square foot, Tier III data center provides companies with disaster recovery services, off-site data storage facilities as well as network redundancy and connection options.

To reduce its carbon footprint and bill customers correctly, Datotel needs visibility of how and where energy is consumed in its data center.

With the facility encompassing thousands of disparate devices, collating power consumption information was a considerable challenge. Datotel's staff had to take individual readings from different systems and manually enter them into spreadsheets for the finance department to invoice customers for their power consumption.

"Our existing system for energy billing was not only time-consuming, but also led to invoicing inaccuracies which often had to be corrected at a later date," comments Brown.

Centralized and integrated monitoring of power consumption

Datotel implemented CA ecoSoftware for the data center in summer 2009. The CA Technologies suite collects information on the power consumed by a variety of devices in Datotel's data center—from generators and UPS systems through to utility feeds and the end sockets in customer cabinets.

Data is displayed in real-time on dashboards that provide at-a-glance visibility of power consumption per customer. The CA Technologies suite also produces historical reports, which Datotel's finance department uses to provide customers with accurate energy bills, and enables operational staff to identify unusual spikes in energy usage that may signify faulty equipment.

"CA ecoSoftware has changed the way we manage our data center," comments Brown. "As well as helping us to minimize downtime, the data provided by the suite has eliminated time-consuming manual tasks."

Since deploying CA ecoSoftware for the data center, Datotel has made a number of interesting findings that will help it to:

- Reduce its own energy usage and costs
- Increase accuracy of customer billing
- Advise customers on how to reduce their carbon footprint.

Brown concludes, "CA ecoSoftware empowers us as a data center provider. We can not only reduce our own energy costs and consumption, but also help our customers achieve the same goal. This will enhance our competitive advantage and enable us to attract more customers."

Section 6: Case study 3

CA Technologies Labs on Demand (LOD) eliminates 6,200 tons from its carbon footprint

To keep up with customer needs, industry standards and new technology, CA Technologies must continually evolve its portfolio of products. The company's developers need access to a variety of server platforms to be able to create and test new products and upgrades.

With development teams spread across four continents, demand for test systems can vary considerably —especially as a product moves through the software development lifecycle.

Providing enough servers to fulfill every peak in demand is simply not economically feasible, and could result in expensive IT assets lying idle for more than 70 percent of the time. As well as controlling operational overhead, CA Technologies is also keen to control its impact on the environment.

In 2008, CA Technologies embarked on its 'Labs on Demand Lab Consolidation' initiative, which provides developers with a shared pool of computing resources with on-demand reservation capabilities.

Since its inception, the Labs on Demand private cloud has grown to include 12,000 servers, approximately 79 percent of which are virtual machines.

Maximizing energy efficiency

To measure and minimize the energy consumed by these devices, the company uses CA ecoSoftware across the two main LOD data centers plus a number of other smaller installations.

The solution has also been installed beyond the LOD and provides branch circuit monitoring and alerting on devices in CA Technologies prime US data center.

CA ecoSoftware also enables the company to track PUE and DCIE metrics for this facility - a capability it hopes to extend to the Labs on Demand data centers in the future.

As well as adopting a proactive approach to efficient energy management, the Labs on Demand initiative has helped CA Technologies:

- Close dozens of legacy labs
- Deploy greener equipment
- Eliminate vented tiles
- Raise chiller temperatures by four degrees
- Raise air handler temperatures by five degrees.

These factors all impact power consumption and contributed to a reduction in CO_2 of 6,200 tons between April 2008 and November 2010.

About CA ecoSoftware

CA ecoSoftware is designed to help organizations meet corporate energy and sustainability goals such as reducing carbon emissions, managing consumption and cutting energy costs. They can become more efficient when using power and natural resources by providing valuable up-to-date information captured from its environment and by supporting its efforts with a systematic governed approach. This information can be communicated to stakeholders and used to drive continuous improvement.

CA ecoSoftware offers a broad range of sustainability management capabilities designed to help manage an organization's sustainability program from strategy to execution. It also includes a robust suite of carbon and natural resource management to measure, calculate and report on energy use, water, waste and the associated GHG emissions across the enterprise. One can measure the environmental performance of sites, facilities and suppliers through assessments, which provide a method and process for capturing the information more efficiently via web-based questionnaires. With operational energy management, organizations can gain greater visibility into energy and other environmental resources in the data center and across the enterprise to visualise, monitor and better manage the use of energy. To learn more about CA ecoSoftware, visit ca.com/ecoSoftware.

CA Technologies is an IT management software and solutions company with expertise across all IT environments—from mainframe and distributed, to virtual and cloud. CA Technologies manages and secures IT environments and enables customers to deliver more flexible IT services. CA Technologies innovative products and services provide the insight and control essential for IT organizations to power business agility. The majority of the Global Fortune 500 rely on CA Technologies to manage their evolving IT ecosystems. For additional information, visit CA Technologies at ca.com.

1 Carbon Disclosure Project, "The IT Solution for the 21st Century", 2011

2 Uptime Institute, "http://www.datacenterknowledge.com/archives/2011/05/10/uptime-institute-the-average-pue-is-1-8/"

3 Forrester Research, Inc., "Cloud Computing Helps Accelerate Green IT", June 30, 2011

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