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Energy management key to green data centers

How to make the operations of a data center 'green' is the number one topic in the IT industry. Wasted energy is a particular issue, certainly in environmental terms but also in terms of cost. Green solutions, many of which already exist, are being increasingly adopted to make the IT world more energy-efficient and environmentally friendly. Monitoring and controlling energy usage through active energy management and system improvements are becoming increasingly popular with data center providers.

Ten years ago the prevailing opinion was that the distributed IT network would have a positive environmental impact. However, the fundamental role that computers now play in all of our lives has inevitably lead to a focus on just how much energy is being consumed. A report recently published in The Sunday Times based on research by Harvard physicist Alex Wissner-Gross, suggests that "performing two Google searches from a desktop computer can generate about the same amount of carbon dioxide as boiling a kettle for a cup of tea."

The newspaper subsequently clarified this by saying that it was based not on a one-hit Google search taking less than a second, but on one that may involve several attempts to find the object being sought that may last for several minutes. Nevertheless, the statement makes for uncomfortable reading – the equivalent of a bathtub full of scalding water every working day, a million times over worldwide. Based on this calculation, Google emits seven grams of CO_2 per search, thereby producing more CO_2 than the entire aviation industry. Google itself states a figure of 0.2 grams of CO_2 per search.

Whichever figure is correct – neither have been independently verified – the fact remains that it is a considerable drain on energy. Greenpeace estimates that by the year 2020, if growth rates do not change, the Internet alone with its servers and data centers will consume almost 2 billion kilowatt hours of energy – more than the power consumption of Germany, France, Canada and Brazil put together. In a report entitled 'Smart 2020' by the Climate Group and the Global e-Sustainability

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initiative (GeSI), it was stated that around 49% of CO_2 emissions in the United States were due to computers and peripheral devices in 2007, a figure that is estimated to rise to 57 percent by 2020.

Wasted energy

One of the main issues for data centers to address is the enormous sums that are wasted every month due purely to inefficiencies. Data centers are responsible for 1.5 percent of the world's energy consumption – a figure that is increasing at a rapid pace. This is completely unnecessary as in most data centers server utilization rarely exceeds six percent and facility utilization can be as low as 50 percent. This results in an estimated 60 million kilowatt hours of energy wasted each year.

With the widely accepted PUE (power usage effectiveness) benchmark launched by the Green Grid organization, a metric now exists to determine the total energy efficiency of data centers. The next step is for power utilization to be optimized. This approach does, of course, involve some very big issues, for example the location of a data center itself. If ambient conditions can be harnessed in order to reduce the cooling load through free cooling or through the use of air-side or water-side economizers, this can have a very significant impact on the overall energy consumption. But, even if a data center has already been built and the location therefore is no longer a consideration, an active approach to energy management can reap real rewards.

Despite energy costs being at an all-time high and expected to double over the next ten years, many providers do not monitor the consumption and power losses of the installed equipment, especially in legacy data centers which are characteristically inefficient. The result is that they are therefore often an unknown quantity, particularly in the partial load range which is the most common mode of operation.

Metering, monitoring and controlling

It is fairly obvious that in order to understand its energy consumption and how it can be optimized, a data center needs to have a means of measuring exactly the amount of power it is using. Energy benchmarking is key to improving energy performance, providing a top level indicator of potential savings. It establishes a baseline for energy use in a typical facility, provides comparisons against similar facilities, identifies operational or maintenance problems, highlights areas for potential improvement and establishes best practice for incorporating into future designs.

Monitoring and control – the "control" part comes from building management systems to actually control the systems, such as turning off or reducing cooling – needs to be put in place to keep track of how and where energy is used within a data center. Such systems are designed to provide

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integrated metering and monitoring to detect and respond to a variety of events that can not only assist in reducing energy consumption but also help warn of situations that actually threaten the operation of the data center.

Active energy management

Cooling is a crucial part of the data center, both in operational and in energy usage terms. Just one degree Celsius more in the server room translates into approximately 3% energy savings. However, integrated systems not only monitor cooling efficiency, but also many other factors which impact on the overall energy usage.

Central to such an active energy management approach is the need for transparency in power flows. Current consumption and power flows need to be analyzed through power monitoring devices, e-counters and communication-capable circuit-breakers. Through communication interfaces, these devices can be integrated into high-level automation and energy management systems that consider energy efficiency in a much more holistic way by integrating all data from the building control, fire safety, security, lighting and power systems.

Energy reports can be generated by these building automation and control systems, with the data retrieved from the process units which record the values delivered by the system's field devices. Trends can be established from a number of different reports including energy consumption, energy costs, CO_2 emissions and comfort requirements.

Key drivers

There are a number of drivers for technological developments in the data center market currently: exploding internet usage globally, an estimated 1.2 billion mobile web users, new legislation on prolonged storage and the impact of cloud computing on IT service business models all among them. However, one of the biggest drivers is energy scarcity. Over the next decade estimates suggest a need for a six times growth in existing server capacity and a 69 times growth in storage capacity. The implications in terms of energy consumption are, not surprisingly, huge: some 10 to 15 new power plants over the next decade in each high density region. The move towards finding green IT solutions is certainly here to stay and transparency is key if a real, measured and meaningful approach to energy efficiency is to be realized.

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