Green computing

Driving intelligent energy management

Architect of an Open World™

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For a long time now, IT has only really been limited by technological progress: as early as 1965, that was effectively fixed by Moore's law, which says that the power of microprocessors is likely to double every two years. Until the middle of the 1990s, the race for ever better performance was the ultimate goal for everyone when, against a background of global cost reduction, people started to focus not so much on performance alone, but more on the performance/price ratio. As increasingly dense technologies and standards have become widespread, it is easier to achieve the required levels of performance at minimum cost. But for several years now, the limitations of this approach have started to become apparent.

The age of intelligent energy management

The power/watt ratio: a new performance indicator

Worldwide collaboration via networks, the increased digitization of content and new demands for computer simulation all require phenomenal computing power and storage. With energy costs rising all the time, simply stacking up processors – with no consideration for anything other than their price tag or the power they provide – is no longer possible.

Nowadays it is the power/watt ratio that is under scrutiny. Bringing energy consumption into the equation means looking at the system over the long term. If we look at the way the power consumption of rack servers evolved between 1999 and 2007, we see it multiplied by more or less a factor of seven over that time, and analysts are suggesting that if it continues at the same rate, the cost of the energy to keep machines running with adequate cooling will soon exceed the initial cost of the hardware. The situation is such that some large data centers will eventually not be able to expand any further, simply because there will be insufficient electrical power available. In short, we cannot continue to blindly pursue 'performance': we need to work towards developing an intelligent approach to energy: optimizing the power/watt ratio in a global and sustainable approach to our IT infrastructures.

Marrying economic and environmental interests

Whatever happens from now on when we design new systems we need to be concerned about energy saving right from the start, with each component selected contributing to overall energy efficiency. Applications must, for their part, make the lowest possible demand on resources; whilst infrastructures, operating systems and operational processes must take their cue from 'tera-architectures', which have already faced the challenges of energy saving on a massive scale because they are so vast.

Of course there are also new avenues to explore, such as renewable energy or, for some global corporations, locating very large data centers in extremely cold regions. But reducing the energy cost of IT also means it has a lower impact on the environment.

In 2007, the ACS (Australian Computer Society) study showed that the carbon footprint of all IT infrastructures in Australian businesses was equivalent to that of whole sectors such as civil aviation or steelmaking. So an intelligent approach to energy can successfully combine economic with environmental interests. Businesses appear to be well aware of this fact themselves. In their last quarterly review, 'Green progress in enterprise IT', research conducted by industry analysts Forrester showed that 38% of enterprises now include respect for the environment among their evaluation criteria and 55% of them put cost reduction at the top of their list of priorities.

Design

Prioritizing energy efficiency

Building a server involves integrating several hundred components within a complex architecture. And just like its functionality and performance, the way a server consumes energy depends on its design, and on how each component – software or hardware - is conceived and interacts with the others in the configuration. Therefore a server's energy efficiency depends on a multitude of parameters, and optimizing them requires advanced technical expertise. With its wide experience gained in the world of mainframes and open systems, Bull is well-placed to capitalize on the best technologies the industry has to offer, and to design and build open servers delivering the highest performance/energy ratios.

Making the most of the latest generations of processors

As essential components within servers, microprocessors make a significant contribution to power consumption. Manufacturers are all too aware of the economic and environmental issues at stake, and are actively committed to designing processors with lower energy consumption. As the market leader, Intel® is constantly innovating in the area of variable-frequency, low-voltage multi-core technologies. These new generations of processors deliver excellent energy consumption while at the same time offering increased flexibility. Bull has established a partnership with Intel to integrate and capitalize on the full potential of its most advanced technologies within the NovaScale® server family. Based around multi-core processors, NovaScale servers provide a higher processing capacity for the same level of energy consumption; delivering savings of up to 60% in power consumption, whilste at the same time achieving ever higher computing performance.
The Escala® server family also provides significant energy savings since the introduction several years ago of the POWER5™ processor. This processor effectively suspends the execution of certain processes when they are not being used. The recently-launched POWER6™ features automated clock control functions, and software interfaces that are entirely dedicated to monitoring energy consumption.
As a result, the system administrator can analyze and manage power consumption for as many servers as necessary.

The benefits of eco-friendly architectures

Despite its fundamental role, the processor is not the only factor influencing a server's global performance levels, or its energy consumption. In fact, the server architecture and its overall design both play decisive roles. Bull's core expertise is in the design of innovative architectures, delivering significant added value. Bull considers the environmental dimension very early in the server design process. In particular, our R&D teams focus on the concept of infrastructures that enable access to critical resources to be shared, with a view to reducing the number of electronic components and cables inside the server, which in turn greatly reduces overall power consumption. Energy profiles for each component (disks, memory) are also assessed individually.

Several studies have shown, meanwhile, that more than 50% of the energy consumed in a data center can be attributed to power supply and cooling systems. This is why Bull has focused a great deal of attention on these areas. As a result, the company has developed alternative cooling solutions, like the liquid-cooled doors designed for high density NovaScale rack servers, most notably for High-Performance Computing (HPC).

As for NovaScale blade servers, these are now equipped with a power supply system to reduce electrical power losses by more than 25%, and a ventilation solution that only consumes a fifth of the power of traditional cooling fans.

VIRTUALIZATION: MAXIMIZING RESOURCE UTILIZATION

Not only does better server design deliver energy savings, but so do infrastructure consolidation and virtualization. These two approaches provide the answer to two major limitations faced by data centers:

- on the one hand a lack of space, which makes it more complicated to deploy new computing capacities and causes a significant rise in temperature;
- and on the other, the under-utilization of servers that are already installed: the American agency for the Protection of the Environment (APE) estimates that only somewhere between 5% and 15 % of available resources in data centers are fully employed.

Thanks in particular to its collaboration with IBM in the development of the AIX® operating system, Bull has built up significant expertise in virtualization. In addition to resource partitioning (present natively in version 5) AIX 6, based on POWER6 servers, is introducing a number of new concepts, in particular possibilities for mobility and cloning of partitions.

In the area of x86 technologies, Bull is integrating VMware's VMotion and DRS solutions within its NovaScale servers, and offering multi-OS platforms to extend the flexibility of servers to the maximum.

Virtualization and consolidation of infrastructures is one of Bull's major areas of expertise, both when it comes to servers and data storage. So, for example, as part of a virtualization project undertaken for Barnsley Metropolitan Borough Council in the United Kingdom, Bull replaced 90 physical servers with just five high-availability servers, cutting the electricity bill by 73% in the process.

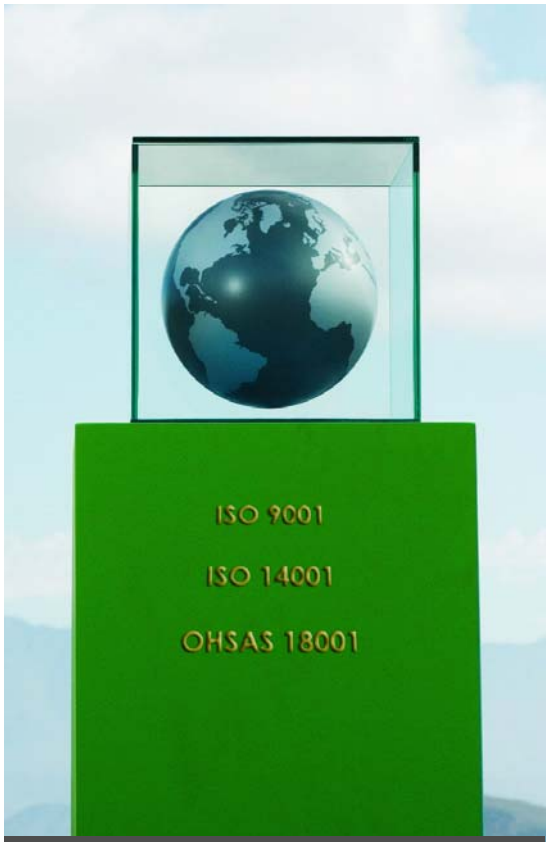
Developing good environmental practices

Over and above the progress made in hardware design, intelligent energy management must also involve the way these systems are operated. Only by putting best practices into operation; paying rigorous attention to waste energy and using it wisely; and coming into line with the norms and standards that are gradually emerging as a result of coordinated efforts on the part of the industry, government authorities and consumers; can we successfully consolidate the gains made by using the latest generations of solutions within the data center.

The energy audit: a first vital step

Conducting an energy audit for a data center involves evaluating its energy efficiency by comparing the total energy consumption for the centre with that of the IT hardware on its own. Originally developed in 2003 by the Lawrence Berkeley National Laboratory at the University of California – and supported by the Green Grid consortium (of which Bull is a contributing member) – the ratio ranges, in the direction of increasing efficiency, between 3.5 and 1.5.

For some years now, the overall ratio has been around 3, with the total energy consumption for the data center divided almost equally between cooling, auxiliary and power supply infrastructures, and the IT hardware itself. It is estimated that by harnessing recent technological advances and combining them with a better level of operational control, we should be able to achieve a ratio of almost 2, or even 1.6 for highly optimized solutions.



'CLEAN' PRODUCTION PROCESSES

Bull was one of the first 100 companies worldwide to implement an integrated QSE (Quality, Safety and Environment) management system for its production and logistics sites. Our policy in this area is driven by three standards:

- ISO 9001:2000 (quality),
- ISO 14001 (environmental management),
- OHSAS 18001 (health and safety).

The initiative was launched in 1990, when Bull first obtained ISO 9001 certification, and reached its successful conclusion in September 2004 with OHSAS 18001 certification. For Bull's customers, this guarantees that products and services delivered are developed under the best possible conditions. Bull's QSE charter can be viewed on our Web site.
In addition, for several years now, Bull has been developing a comprehensive corporate policy to address the environmental impact of any given product during its entire life cycle. This begins with a very demanding partnership and purchasing policy, and responsible business practices. The design process incorporates European directives including RoHS, aimed at reducing the use of certain dangerous substances, and WEEE, which regulates the treatment of electronic waste and by-products. Finally, Bull has put in place an efficient recycling chain: every year the manufacturing site at Angers collects the equivalent of 50% of all the hardware it delivers in France, and succeeds in recycling 90% of the waste collected.

One of the advantages of the energy audit is that it can provide a global indicator for the data center, and therefore help us define an energy efficiency target that can be shared by all parties involved. It is too often the case, as several studies conducted over the last few years have shown, that IT Departments are unaware of ongoing energy costs, and so lack any incentive to try and reduce them. Bull provides consultancy and support drawing up energy reports, establishing scenarios for optimization and improving the overall energy efficiency of the data center.

Day-to-day operations management and an intelligent approach to energy
The extent to which the data center can be described as 'energy efficient' doesn't just depend on the energy profiles of the hardware installed within it but also, to a large extent, on its operational management. Through the clever use of various energy-saving methodologies, this involves most importantly controlling the environmental factors associated with the density of certain computing zones, power consumption and thermal dissipation.

To successfully achieve energy efficiency, energy policy guidelines must form a central pillar of the control system for the whole infrastructure. In real terms, this can mean integrating thermal sensors and sensors for measuring electrical consumption within the system administration, which automatically regulate the intensity of cooling devices and extractors. Another very relevant current practice involves scheduling server activities in line with the enterprise's core business processes, to ensure automated control of system shutdowns and start-ups.
These kinds of considerations are now part and parcel of Bull's approach when working in the field of operations management, the objective being to provide both tools – notably Open Source tools – and professional, structured methodologies that guarantee optimum energy management for both physical and virtual infrastructures.

The future belongs to the Bio Data Center™

Looking forward

In the era of the digital economy, where speed and flexibility are essential, the data center has to adapt to the pace of an enterprise's business activity. But the dynamics of the international marketplace, regulatory constraints, security requirements, demands for sustainable development, and even the way technologies are evolving with increasing numbers of multi-core architectures and denser servers all pose serious challenges for the IT Department. Adopting a new approach to the data center is vital in order to respond sufficiently quickly and efficiently. If we are to marry flexibility, performance and an optimized carbon footprint, today's IT center must undergo a transformation - into the Bio Data Center.

Tough and pragmatic principles

With its vast experience of complex architectures, heterogeneous environments and the implementation of tera-architectures, Bull provides a pragmatic approach based on three fundamental principles:

- Delivering the service levels that users demand (through Service Level Agreements or SLAs) by automating and streamlining operational processes
- Optimizing data center topology to liberate all the available power and increase flexibility
- Controlling heterogeneity and reducing the carbon footprint.

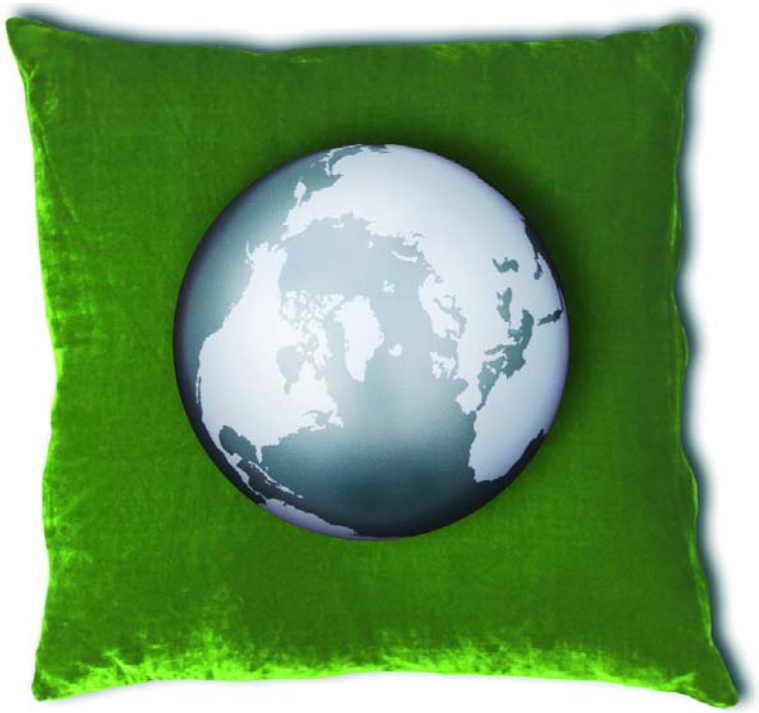
Managed according to these fundamental rules, the Bio Data Center fits more naturally into its physical and business environments and can therefore evolve in much the same way as a living organism: continuously, as dictated by its needs, with each element contributing to overall growth while respecting the key functional and energy balances. Bull also applies these principles to its own data centers, creating, for example, differentiated high and low-density areas.

Application mobility supporting eco-efficiency

One of the concepts being explored by Bull to improve the way energy distribution and cooling are handled within the data center is the design of a new solution that can automatically control server's load mobility. This involves diverting heavy server's load, which creates 'hot spots' in the data center, to cooler zones that have the necessary processing capacity available. This approach entails developing detection sensors – work that is currently in progress – designed to be installed within the server system interface,
the data center installation area as a whole, the cooling infrastructures, the power distribution chain and throughout the whole building. When combined with new virtualization technologies, this solution allows us to envisage self-regulating data center systems in the future, whether these concern computing capacity, energy management, configuration of virtual partitions and servers, or distribution of application load. This opens up new avenues for running data centers that are economical, environmentally responsible, and able to evolve and grow organically as the enterprise itself progresses.

The green generation of Data Centers

Cutting-edge solutions to minimize the carbon footprint
of your IT infrastructures



Bull is a member of Green Grid and Climate Savers Computing Initiative

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