Green Computing - New Horizon of Energy Efficiency and E-Waste Minimization – World Perspective vis-à-vis Indian Scenario

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ABSTRACT

Thrust of computing was initially on faster analysis and speedier calculation and solving of mare complex problems. But in the recent past another focus has got immense importance and that is achievement of energy efficiency, minimization of power consumption of e-equipments. It has also given utmost attention to minimization of e-waste and use of non-toxic materials in preparation of e-equipments. World leaders have also taken move towards this by following some principles. Now it is the time for the end user community to follow some rules of thumb to achieve partly the benefit of "Green Computing". In India, the implement-ability of principle of "Green Computing" is facing a dilemma due to many socio-economic matters and those are linked to be soughed out to pull India in the mainstream movement of "Green Computing".

Keywords : E-waste, Toxic, Non-conventional Energy, Eco-Friendly, Bioplastics, Landfills

1. Introduction

Green computing is the practice of using computing resources efficiently. The goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. Such practices include the implementation of energy-efficient central processing units (CPUs), servers and peripherals as well as reduced resource consumption and proper disposal of electronic waste (e-waste). In 1992, the U.S. Environmental Protection Agency launched Energy Star, a voluntary labeling program which is designed to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. The term "green computing" was probably coined shortly after the Energy Star program began; there are several USENET posts dating back to 1992 which use the term in this manner.

2. Problems

Performance-wise, computer design has progressed staggeringly well and astonishingly fast but looking at it from a green perspective, the work is at its epoch. It takes a lot of energy to create, package, store, and move. Conventionally, manufacturing computers includes the use of lead, cadmium, mercury, and other toxics in general. Usually, computers can contain 4 to 8 pounds of lead alone, according to green experts. It's no wonder that computers and other electronics make up two-fifths of all lead in landfills. To counter this growing pollution threat all over the world due to the growing use of electronic device in general and

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computers in particular there is a need to look for a eco-friendly computer.

"Data center servers use 50 times the energy per square foot as an office [does]," says Mark Bramfitt, principal program manager at PG&E. Data centers are the main reason behind energy consumption, Energy consumed by data centers in the United States and worldwide doubled from 2000 to 2005, according to Jonathan Koomey, a consulting professor at Stanford University and staff scientist at Lawrence Berkeley National Lab. As a result, some companies are chasing cheaper data center power. Google is building a data center on Oregon's Columbia River to tap hydroelectric power, while Microsoft builds nearby in Washington for the same reason. Financial services company HSBC is building a data center near Niagara Falls.

To keep servers at the right temperature, companies mainly rely on air-conditioning equipments. The more powerful the machine, the more cool air needed to keep it from overheating. By 2005, the energy required to power and cool servers accounted for about 1.2% of total U.S. electricity consumption, according to a report released in February by staff scientist Jonathan Koomey of Lawrence Berkeley National Laboratory and sponsored by chip manufacturer AMD (AMD). According to Gartner by 2010, about half of the Forbes Global 2000 companies will spend more on energy than on hardware such as servers. Energy costs, now about 10% of the average IT budget, could rise to 50% in a matter of years, Kumar says.

Faster processors use more power, because they use too much power and their waste heat increases temperature for which air conditioning necessary, especially in server farms--between the computers and the HVAC. The waste heat also causes reliability problems, as CPU's crash much more often at higher temperatures.

3. The way out

The work habits of computer users and businesses can be modified to minimize adverse impact on the global environment. Here are some steps that can be taken:

- Virtualization is one of the most effective tools for more cost-effective, greener-energy efficient computing where each server is divided into multiple virtual machines that run different applications and in this way companies can increase their server utilization rates. This approach is so energy friendly that California utility PG&E offers rebates of $300 to $600 for each server that companies eliminate using Sun or VMware virtualization products, with a maximum rebate of $4 million or 50% of the project's cost, whichever is less.
- More-efficient processors are another critical energy-saving element, as Intel, Advanced Micro Devices, and Sun Microsystems all have adopted the green religion. Sun's betting on multicore chip efficiency to fuel interest in new high-end servers. Its 32-thread Niagara 1 chip, Ultrasparc 1, consumes 60 to 62 watts, while the Niagara 2 chip due in the second half will have 64 threads yet run at 80 watts only, says chief architect Rick Hetherington.
- Setting the Power Options of computer to switch to sleep mode when it's not active is a good practice. We can find the power options settings in PC's Control Panel. It enables PC's to go to stand-by mode and turn off the monitor when the PC is idle for a few minutes.
- It is better to do computer-related tasks during contiguous, intensive blocks of time, leaving hardware off at other times.
- Flat panel monitors use less energy than traditional CRT monitors. Avoidance of the use of screen savers contribute to energy savings by allowing a monitor to enter in stand-by mode.
- Smaller form factor (e.g. 2.5 inch) hard disk drives often consume less power than physically larger drives.Unlike hard disk drives, solid-state drives store data in flash memory or DRAM. With no moving parts, power consumption may be reduced somewhat for low capacity flash based devices.

- Print only what we need and use of recycled content paper whenever possible is another good practice. Most printers today have a two-sided printing option which can dramatically reduce paper consumption. Recycled used ink and toner cartridges may also be used.
- It is important to design computers which can be powered with low power obtained from non-conventional energy sources like solar energy, pedaling a bike, turning a hand-crank etc.
- Energy efficient display options include:
  - No video card or use of shared terminal, shared thin client, or desktop sharing software if display required.
  - Use motherboard video output - typically low 3D performance and low power.
  - Reuse of older video card that uses little power; many of which do not require heatsinks or fans.

4. Role of IT Vendors

IT vendors also are applying green standards to their own operations. The reasons are ::

- New revenue opportunities
- Fear of a customer backlash
- Desire to act like good corporate citizens

Sun created a Sun Eco office to oversee all of the company's green programs, including telecommuting but also core products such as low-power servers.

Dell in February launched "Plant A Tree For Me," where consumers pay an extra $2 for a laptop or $6 for a desktop to plant trees aimed at offsetting the equivalent computer emissions. It launched www.dell.com/earth to tout its green policies.

5. Eco Friendly Approach

Electronics giants are about to roll out eco-friendly range of computers (like desktops and laptops) that aim at reducing the e-waste in the environment. They are likely to be free of hazardous materials such as brominated flame-retardants, PVCs and heavy metals such as lead, cadmium and mercury, which are commonly used in computer manufacturing.

Reliability about the use of green materials in computer is perhaps the biggest single challenge facing the electronics industry. Lead-tin solder use of today is very malleable making it an ideal shock absorber. So far, more brittle replacement solders have yet to show the same reliability in real-world applications. Replacements like the front-runner, a tin/copper/silver alloy, also require higher melting temperatures, which can affect chip life.

Here's how designers plan to make future computer more eco-friendly across its entire life span, from manufacture to recycling:

- energy-intensive manufacturing of computer parts can be minimized by making manufacturing process more energy efficient
- by replacing petroleum-filled plastic with bioplastics—plant-based polymers— which require less oil and energy to produce in comparison to traditional plastics with a challenge to keep these bioplastic computers cool so that electronics won't melt them
- landfills can be controlled by making best use of the device by upgrading and repairing in time with a need to make such processes (i.e., upgradation and repairing) easier and cheaper
- avoiding the discarding will not only control e-waste out of dumps but also save energy and materials needed for a whole new computer
- power-sucking displays can be replaced with green light displays made of OLEDs, or organic

light-emitting diodes

- use of toxic materials like lead can be replaced by silver and copper making recycling of computers (which is expensive and time consuming at present) more effective by recycling computer parts separately with a option of reuse or resale

6. Perspective with respect to Indian Scenario

For a long time there was no considerable improvement in the growth of indigenous authentic hardware equipment manufacturer in the country and almost every companies and the household customers were dependant on foreign companies who were either importing the equipments or producing part of them in Indian subsidiaries. Mainly those subsidiaries were using the low priced human resource for assembling purpose (following the Ricardian theory of competitive cost advantage)

Lack of basic research initiative and congenial infrastructure has resulted in absence of good patents and commercial production of indigenously built equipments. Due to tax relief given by the Government in the last few years for importing computer hardware accelerated the import and resulted in the minimization of the machines, equipments and peripherals. In this situation many small and medium scale industries were induced to start procuring the hardware at low prices and venture into the building of IT infrastructure for the company. But during the activities price was the most important criterion. At that point of time the basic objective was to build basic infrastructure without considering the principle of green computing. In the later stage when at the recent time the concept is grown enough it is not possible for most of the small and medium scale companies to redo the task of IT infrastructure development over and above bearing the cost of maintenance and procurement of software.

Even with the old non green hardware it was observed that most of the boards (Around 73.78 % as found in local survey in and around Kolkata, Siliguri, ADDA) faced a question by the stakeholders about the justification for the IT expenditure and they also insisted to calculate the cost benefit ratio of the investment and unfortunately most of the boards failed to give good answer due to confusion and initial fault in planning which resulted in the massive underutilization of the equipments and failure of MID which was not very prudent and robust with respect to the changing business dynamics.

So in the backdrop of the above discussion it can be concluded that most of the SMEs will not be interested right now to change their IT infrastructure to green infrastructure. Even if they are concerned about the concept they will wait until the cost is recovered from the old infrastructure. Though when they will procure any new equipment they will have a choice of green equipment but in that case also price will play a deterrent role decision-making. Regarding the large companies and MNCs cost of procurement of new green equipments is not very tough but again disposal of the old equipments is not a very easy task. Apart from this the problem of homoeostasis of the employee is also a negative factor.

Again most of the large companies now a days gone for implementation of Enterprise Resource Planning package or at least started using large customized software coupled with use of Database Management Systems and eventually having very large distributed database in different servers. They may also have massive networking infrastructure or Client Server Architecture and at this stage it is really not easy to switch over to new equipments and reinstate the operation without any effect to the soft resources and connectivities and data communications at different level.

In India the IT backed business intelligence and operation is now in a growth phage and the stakeholders are really concerned to maximize the return on investment and as a result of this it will not be easy to implement the principle of green computing in the IT infrastructure.

Moreover the human resource of the country is not very much concerned with the effect of toxic materials used in the equipments and so no public movement is visible now in regard to this object.

At present if the Government through legislation make it mandatory on the part of the Companies to comply with the green standard then the green movement may start in the country in a conspicuous manner. But as in every other cases until the awareness is built up there will be no true development of green computing in the country.

The awareness programme may include the following major issues:

- Green computing minimizes the energy consumption of the organization i.e. minimizes the power bill.
- Use of non-toxic material in the equipments make the worker safe from health problem and occupational hazards.
- It saves the resource of the country as a whole.
- In the long term these green equipment will be less costly without any hidden cost of waste and enhanced resource consumption with out any detrimental effect of accuracy, performance and longevity.

7. Concluding Remarks

So far, consumers haven't cared about ecological impact when buying computers, they've cared only about speed and price. But as Moore's Law marches on and computers commodities, consumers will become pickier about being green. Devices use less and less power while renewable energy gets more and more portable and effective. The greenest computer will not miraculously fall from the sky one day, it'll be the product of years of improvements.

References

1. http://en.wikipedia.org/wiki/Green_computing, accessed during May- July 2008
2. http://www.csi-india.org/green-computing, accessed during May- July 2008
3. http://www.techno-preneur.net/information-desk/sciencetech- magazine/2007/nov07/GreenComputing.pdf, accessed during May- July 2008
4. http://www.wipro.co.in/products/greenpc/html/0007clip.htm, accessed during May- July 2008
5. http://www.tech-faq.com/green-computing.shtml, accessed during May- July 2008
6. Srivastava, M (2007) *Chemistry for Green Environment*
7. Gary B. S (2002)*Discovering Computers*: *Concepts for a Digital World*, Complete Shelly Cashman Series: Complete
8. Sivaharan, T, Blair, G. and Coulson, G (2005), GREEN: A Configurable and Re-configurable Publish-Subscribe Middleware for Pervasive Computing - lecture Notes in Computer Science, 2005 – Springer

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