Approaches to Green Computing to Reduce Global Warming

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ABSTRACT

In accordance to Green Computing of San Murugesan the Designing, manufacturing, using, and disposing of computers, servers, and associated subsystems, efficiently and effectively with minimal or no impact on the environment pollution is the need of the hour. The IT & Computer Technology like Automobile Industry has created serious environmental problems such as CO2 emission and Global Warming Issues. The use of any machine with minimum energy and maximum efficiency to protect environmental balance while we make our life comfortable and productive is the need. This paper is a step in achieving green computing by suggesting means and ways to achieve the same.

Key words: Green IT, recyclability, biodegradability, ecological footprint, Virtualization, Resource allocation

Introduction

This paper is based on the environment and related factor which is to harmful to earth Green IT, refers to environmentally sustainable computing or IT. In the article Harnessing Green IT: Principles and Practices, San Murugesan defines the field of green computing as "the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems—such as monitors, printers, storage devices, and networking and communications systems—efficiently and effectively with minimal or no impact on the environment. The goals of green computing are similar to green chemistry; reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Research continues into key areas such as making the use of computers as energy-efficient as possible, and designing algorithms and systems for efficiency-related computer technologies

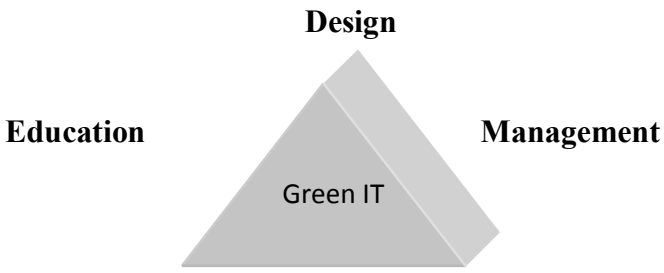

Figure 1: Technologies for reduce the global Warming

Product longevity

Gartner maintains that the PC manufacturing process accounts for 70 % of the natural resources used in the life cycle of a PC. Therefore, the biggest contribution to green computing usually is to prolong the equipment's lifetime. Another report from Gartner recommends to "Look for product longevity, including upgradability and modularity."For instance, manufacturing a new PC makes a far bigger ecological footprint than manufacturing a new RAM module to upgrade an existing one, a common upgrade that saves the user having to purchase a new computer.

Software and deployment optimization

Algorithmic efficiency

The efficiency of algorithms has an impact on the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs. While algorithmic efficiency does not have as much impact as other approaches, it is still an important consideration. A study by Alex Wissner-Gross, a physicist at Harvard, estimated that the average Google search released 7 grams of carbon dioxide (CO_2). However, Google disputes this figure, arguing instead that a typical search produces only 0.2 grams of CO_2.

Resource allocation

Algorithms can also be used to route data to data centers where electricity is less expensive. Researchers from MIT, Carnegie Mellon University, and Akamai have tested an energy allocation algorithm that successfully routes traffic to the location with the cheapest energy costs. The researchers project up to a 40 percent savings on energy costs if their proposed algorithm were to be deployed. Strictly speaking, this approach does not actually reduce the amount of energy being used; it only reduces the cost to the company using it. However, a similar strategy could be used to direct traffic to rely on energy that is produced in a more environmentally friendly or efficient way. A similar approach has also been used to cut energy usage by routing traffic away from data centers experiencing warm weather; this allows computers to be shut down to avoid using air conditioning.

Larger server centers are sometimes located where energy and land are inexpensive and readily available. Local availability of renewable energy, climate that allows outside air to be used for cooling, or locating them where the heat they produce may be used for other purposes could be factors in green sitting decisions.

Virtualization

Computer virtualization refers to the abstraction of computer resources, such as the process of running two or more logical computer systems on one set of physical hardware. The concept originated with the IBM mainframe operating systems of the 1960s, but was commercialized for x86-compatible computers only in the 1990s. With virtualization, a system administrator could combine several physical systems into virtual machines on one single, powerful system, thereby unplugging the original hardware and reducing power and cooling consumption. Virtualization can assist in distributing work so that servers are either busy, or put in a low power sleep state. Several commercial companies and open-source projects now offer software packages to enable a transition to virtual computing. Intel Corporation and AMD have also built proprietary virtualization enhancements to the x86 instruction set into each of their CPU product lines, in order to facilitate virtualized computing.

Terminal servers

Terminal servers have also been used in green computing. When using the system, users at a terminal connect to a central server; all of the actual computing is done on the server, but the end user experiences the operating system on the terminal. These can be combined with thin clients, which use up to 1/8 the amount of energy of a normal workstation, resulting in a decrease of energy costs and consumption. There has been an increase in using terminal services with thin clients to create virtual labs. Examples of terminal server software include Terminal Services for Windows and the Linux Terminal Server Project (LTSP) for the Linux operating system.

Power management

The Advanced Configuration and Power Interface (ACPI), an open industry standard, allows an operating system to directly control the power-saving aspects of its underlying hardware. This allows a system to automatically turn off components such as monitors and hard drives after set periods of inactivity. In addition, a system may hibernate, where most components (including the CPU and the system RAM) are turned off. ACPI is a successor to an earlier Intel-Microsoft standard called Advanced Power Management, which allows a computer's BIOS to control power management functions. Some programs allow the user to manually adjust the voltages supplied to the CPU, which reduces both the amount of heat produced and

electricity consumed. This process is called undervolting. Some CPUs can automatically undervolt the processor depending on the workload; this technology is called "SpeedStep" on Intel processors, "PowerNow!"/"Cool'n'Quiet" on AMD chips, LongHaul on VIA CPUs, and LongRun with Transmeta processors.

Data center power

Data centers, which have been criticized for its extraordinary high energy demand, are a primary focus for proponents of green computing. The federal government has set a minimum 10% reduction target for data center energy usage by 2011. With the aid of a self-styled ultra efficient evaporative cooling technology, Google Inc. has been able to reduce its energy consumption to 50% of that of the industry average.

Operating system support

The dominant desktop operating system, Microsoft Windows, has included limited PC power management features since Windows 95. These initially provided for stand-by (suspend-to-RAM) and a monitor low power state. Further iterations of Windows added hibernate (suspend-to-disk) and support for the ACPI standard. Windows 2000 was the first NT based operating system to include power management. This required major changes to the underlying operating system architecture and a new hardware driver model. Windows 2000 also introduced Group Policy, a technology which allowed administrators to centrally configure most Windows features. However, power management was not one of those features. This is probably because the power management settings design relied upon a connected set of per-user and per-machine binary registry values,[1] effectively leaving it up to each user to configure their own power management settings.

This approach, which is not compatible with Windows Group Policy, was repeated in Windows XP. The reasons for this design decision by Microsoft are not known, and it has resulted in heavy criticism. Microsoft significantly improved this in Windows Vista by redesigning the power management system to allow basic configuration by Group Policy. The support offered is limited to a single per-computer policy. The most recent release, Windows 7 retains these limitations but does include refinements for more efficient user of operating system timers, processor power management, and display panel brightness. The most significant change in Windows 7 is in the user experience. The prominence of the default High Performance power plan has been reduced with the aim of encouraging users to save power.

Power supply

Desktop computer power supplies (PSUs) are generally 70–75% efficient, dissipating the remaining energy as heat. An industry initiative called 80 PLUS certifies PSUs that are at least 80% efficient; typically these models are drop-in replacements for older, less efficient PSUs of the same form factor.[30] As of July 20, 2007, all new Energy Star 4.0-certified desktop PSUs must be at least 80% efficient.

Storage

Smaller form factor (e.g. 2.5 inch) hard disk drives often consume less power per gigabyte 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.

In a recent case study, Fusion-io, manufacturers of the world's fastest Solid State Storage devices, managed to reduce the carbon footprint and operating costs of MySpace data centers by 80% while increasing performance speeds beyond that which had been attainable via multiple hard disk drives in Raid 0. In response, MySpace was able to permanently retire several of their servers, including all their heavy-load servers, further reducing their carbon footprint.

As hard drive prices have fallen, storage farms have tended to increase in capacity to make more data available online. This includes archival and backup data that would formerly have been saved on tape or other offline storage. The increase in online storage has increased power consumption. Reducing the power consumed by large storage arrays, while still providing the benefits of online storage, is a subject of ongoing research.

Display

CRT monitors typically use more power than LCD monitors. They also contain significant amounts of lead. LCD monitors typically use a cold-cathode fluorescent bulb to provide light for the display. Some newer displays use an array of light-emitting diodes (LEDs) in place of the fluorescent bulb, which reduces the amount of electricity used by the display. Fluorescent back-lights also contain mercury, whereas LED back-lights do not.

Materials recycling

Recycling computing equipment can keep harmful materials such as lead, mercury, and hexavalent chromium out of landfills, and can also replace equipment that otherwise would need to be manufactured, saving further energy and emissions. Computer systems that have outlived their particular function can be re-purposed, or donated to various charities and non-profit organizations. However, many charities have recently imposed minimum system

requirements for donated equipment. Additionally, parts from outdated systems may be salvaged and recycled through certain retail outlets and municipal or private recycling centers. Computing supplies, such as printer cartridges, paper, and batteries may be recycled as well.

A drawback to many of these schemes is that computers gathered through recycling drives are often shipped to developing countries where environmental standards are less strict than in North America and Europe. The Silicon Valley Toxics Coalition estimates that 80% of the post-consumer e-waste collected for recycling is shipped abroad to countries such as China and Pakistan.

The recycling of old computers raises an important privacy issue. The old storage devices still hold private information, such as emails, passwords and credit card numbers, which can be recovered simply by someone using software that is available freely on the Internet. Deletion of a file does not actually remove the file from the hard drive. Before recycling a computer, users should remove the hard drive or hard drives if there is more than one, and physically destroy it or store it somewhere safe. There are some authorized hardware recycling companies to whom the computer may be given for recycling, and they typically sign a non-disclosure agreement.

Telecommuting

Teleconferencing and telepresence technologies are often implemented in green computing initiatives. The advantages are many; increased worker satisfaction, reduction of greenhouse gas emissions related to travel, and increased profit margins as a result of lower overhead costs for office space, heat, lighting, etc. The savings are significant; the average annual energy consumption for U.S. office buildings is over 23 kilowatt hours per square foot, with heat, air conditioning and lighting accounting for 70% of all energy consumed. Other related initiatives, such as hotelling, reduce the square footage per employee as workers reserve space only when they need it. Many types of jobs, such as sales, consulting, and field service, integrate well with this technique.

Education and Certification

There are a number of colleges that have individual green computing courses and institutions that offer certifications which indirectly encourage green computing techniques. Full fledged green computing degree programs and certifications are currently in their infancy but should grow over time as their definition and importance mature.

PC power management

Research shows that in the US, 50% of PCs are left on overnight, resulting in an estimated annual energy waste of 28.8 billion KWH, and a cost of $2.8 billion to the economy. User behavior is slightly different in Europe, with approximately 28% of PCs being left on overnight in the UK, resulting in an estimated energy loss of 2.5 billion KWH, costing 12000 million. In Germany, with approximately 30% of PCs left on overnight, it is estimated 4.8 billion KWH of energy are wasted each year, costing €919 million

User behavior is a big factor in energy waste by PCs, through people not turning off their PCs when they leave work, but network processes also compound the problem.

Managing energy use by PCs attached to IT networks is difficult due to network processes making a PC's internal power profiles ineffective. Because processes on the network are constantly providing inputs to the PC, the machine fails to recognize that there is no user input, and fails to go into its low-power mode.

PC power management is a classic problem of distributed demand management, where individual devices which have a relatively low power demand result in a very large cumulative energy demand.

Addressing this problem requires specialized power management software. These tools are highly effective at cutting power demand by PCs, saving of 40% on average can be made using this software. Typical savings per PC are $35 and 200 kg CO_2 per PC per year

Conclusion

The IT and computer revolution has changed the life of human beings with maximum speed, efficiency and productivity. The IT and computers are a tool and not the objectives .they are means and not the end goals. On one side man has achieved more comfort and efficiency but on the other side added CFC's i.e. chlorofluro compounds and Carbons and CO2 to cause Global warming as the machines are growing in strengths and efficiency man too must grow sensitive and environmentally friendly. The balanced growth with respect to social and environmental point of view will be the solution to enjoy long and healthy life..

While using machines simple care such as

1. Using Auto Stop soft ware to shut off machines when they are idle for long.
2. Using biodegradable materials.
3. Proper management like putting off the systems before leaving work place for the day
4. Recycling and donating computers of previous generations to less fortunate as social responsibility to maximum use.etc will help us to maintain the balance in NEED and WANTS or GREED.

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