GREEN COMPUTING: AN ECO- FRIENDLY APPROACH TOWARD COMPUTING

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ABSTRACT

This century is the century of IT revolution, advanced computers, and other electronic items. Due to rapid technological advancements, excessive dependence and tremendous use of electronic items; carbon emission, global warming, climate change and saving our environment and ecology have become hot issues. Public as well as private sectors and societies have a new important agenda of tackling environment issues and adopting environment-friendly practices in the sector of computing as well. To reduce computer's environmental problems and to create a sustainable environment, we need to move towards Green Computing. Green Computing or Green IT benefits the environment by improving energy efficiency, lowering green house gas emissions using less harmful materials and encouraging reuse and recycling of the various components of electronic waste. The goals of green computing are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and electronic waste. This paper highlights the impact of green computing on our environment. Further how the fast pace of IT Revolution has created several serious environmental issues which needs to be solved with the help of green approach towards the computing.

Keywords: Green Computing, E-waste, Energy Saving, Environment, Hazardous Waste.

INTRODUCTION

"Green" has become a popular term for describing things that are good for the environment, generally healthful and, more recently, economically sensible. "Going Green" implies reducing one's energy use and pollution footprint. The technology community, specifically computer users, have popularized the term "Green Computing," which is indicative of the reduction of the pollution and energy footprint of computers. Green computing refers to "environmentally sustainable computing" which studies and practices virtually all computing efficiently and effectively with little or no impact on the environment. There are several facets to achieve green computing such as designing, manufacturing, using, and disposing computing components including hardware and software

The ideas or design of Green Computing has to go through the following steps:

1. **Green use** — reducing the energy consumption of computers and other information   systems as well as using them in an environmentally friendly manner.

2. **Green disposal** — reusing old computers and properly recycling unwanted computers and other electronic equipment.

3. **Green design** — designing energy-efficient and environmentally sound components, computers, servers, cooling equipment, and data centers.

4. **Green manufacturing** — manufacturing electronic components, computers, and other associated subsystems with minimal impact on the environment.

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Figure 1: Cycle of Green Manufacturing

Design for environmental principles
Reduction of toxic substances
Rapid prototyping
Recyclability

Design

Reuse
Disassemble
Mono materials
Low cost of disposal

Remanufacture

Procure

Supplier compliance
Recirculation of packaging
Eco –efficient supply

Green
Manufacturing

Reliable to end of life
Low energy costs
Emission free use
Low consumable use

Customer
Use to end
of life

Manufacture

Resource efficient
Energy efficient
Emission/toxic free
Lean, Safe

Packaging &
Distribution

Returnable
Reusable
Recyclable

Source: Frost & Sullivan

History/Origin

The origin of green computing can be traced back to the launching of *Energy Star* program in the year 1992 by the U.S. Environment Protection Agency(EPA). It was a voluntary labeling program to Differentiate between energy efficiency of various e-product viz. computer monitors, climate control equipment and other technologies. This resulted in starting of sleep mode function of computer monitors.

The Swedish organization TCO Development launched the TCO Certification program to promote low magnetic and electrical emissions from Cathode Ray Tube-based computer displays; gradually the different parameters have emerged over the year in the field of green computing

Negative impact on Environment

Computers facilitate faster analysis, and speedier calculation. These have made possible harnessing the wealth of the knowledge of the internet, the instantaneous communication, and the sophisticated tools that help us work and create and share and to solve more and more complex problem. At the same time computers also add to environment problems which most of us don't realize. Computer affects our environment in several different ways. Each stage of a computer's life, from its production, throughout its use, and its disposal, presents environmental problems.

Computer is made up of various hazardous, toxic materials such as lead, mercury and hexavalent chromium. This computer waste is a major source of widespread damage to the environment at large. Toxic materials are present in computer wastes   primarily consisting of Cathode Ray Tubes (CRTs), Printed board assemblies, Capacitors, Mercury switches and relays, Batteries, Liquid Crystal Displays (LCDs), and Electrolytes. Computer waste contains toxic substances such as lead and cadmium in circuit boards; lead oxide and cadmium in monitor Cathode Ray Tubes (CRTs); mercury in switches and flat screen monitors; cadmium in computer batteries; polychlorinated biphenyls (PCBs) in older capacitors and transformers; and brominated flame retardants on printed circuit boards, plastic casings, cables and Polyvinyl Chloride (PVC) cable insulation that releases highly toxic dioxins and furans when burned to retrieve copper from the wires. All electronic equipments contain printed circuit boards which are hazardous because of their content of lead.

Land filling of e-wastes can lead to the leaching of lead into the ground water. If the CRT is crushed and burned, it emits toxic fumes into the air. These products contain several rechargeable battery types, all of which contain toxic

substances that can contaminate the environment when burned in incinerators or disposed of in landfills. The cadmium from one mobile phone battery is enough to pollute 600 cu.m of water. The quantity of cadmium in landfill sites is significant, and considerable toxic contamination is caused by the inevitable medium and long-term effects of cadmium leaking into the surrounding soil. Because plastics are highly flammable, the printed wiring board and housings of electronic products contain brominated flame retardants, a number of which are clearly damaging to human health and the environment.

Total electrical energy consumption by servers, computers, monitors, data communications equipment, and cooling systems for data centers is steadily increasing. This increase in energy consumption is directly related to the increased greenhouse gas emissions. Each PC in use generates about a ton of carbon dioxide every year. The progress in the field of computer hardware has been achieved tremendously but looking at the green perspective, work has rarely begun. In reality development of green computing started lately. Green computing or Green IT means environmentally sustainable computing. It is also defined as the study and practice of designing, manufacturing, using, and disposing of computers 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.

Green computing practices

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

Computer virtualization is the process of running two or more logical computer systems on one set of physical hardware. The concept originated with the 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. 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.

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.

Efficient processors

More-efficient processors are another critical energy-saving element, as Intel, Advanced Micro Devices, and Sun Microsystems all have adopted the green religiontechnology. Sun is 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

Turn Off Equipment When Not In Use

Powering down equipment is the simplest, most effective and most obvious way to reduce computing power consumption. Computers have become such a standard part of daily life that many computers are left powered on around the clock, and are often done as a convenience to the user. This convenience is costly since the simple act of powering off a computing device will significantly reduce its power consumption, although it is important to note that many devices may still consume a small amount of power or "phantom load."

Computer Power Savings Modes

- **Screen Savers**

One of the simplest and most familiar power saving methods is the proper use of screen savers. The typical graphical screen saver originally designed to minimize "burn-in" of computer monitors, actually increases power consumption. Rather than using a 3D graphics screen saver, and with screen burn-in no longer a concern, power use easily can be reduced by disabling screen savers. In this way, power consumed by intensive graphics is eliminated, leading to the monitor "falling asleep" after a period of idling, automatically conserving still more power.

- **Monitor Sleep Mode**

Allowing the monitor to fall asleep after idling for some time period is another easily employed method for improving energy efficiency. When a monitor falls asleep or enters a "Standby" mode, it enters a low power consumption state. The monitor screen will be blank, with no light emitting from it. For example, a Dell 20″ widescreen LCD uses approximately 55 watts of power when it is on. In sleep mode, the power use drops to around 3 watts, resulting in significant energy savings. Setting the sleep mode is done via an operating system's power options control panel, with a sleeping monitor able to be woken within a couple of seconds by moving the mouse or typing a key on the keyboard. Monitors should be configured to fall asleep in the classroom, office and at home.

- **Hard Disk Sleep Mode**

A computer can place its hard disk drives in a low power sleep mode when they are idle. Hard disk drives on desktop computers can use 10 watts or more when in use, while notebook computer drives use less but energy savings have the benefit of extending battery charge life. Operating system settings again manage this mode automatically once configured. A hard disk drive that falls asleep is awakened within a couple of seconds by moving the mouse or typing a key on the keyboard. This setting provides a small savings and is minimally intrusive, with more significant savings possible using system standby mode.

- **System Standby Mode**

System standby is one of the most effective power saving features. After a preset idling period, a computer will shutdown most of its components significantly reducing power use. Volatile memory remains active so that whatever the user was working on will still be there when the computer wakes up from standby mode. A desktop computer that uses more than 100 watts idling can use as little as 5 watts when in standby mode, using one twentieth of the electricity it used when idling. Wake up time for system standby mode requires a few seconds, a delay that users may not be accustomed to. Standby mode is much faster than shutting down and later powering on the computer, and it preserves the computer's state in memory, making it preferable for users seeking a balance between convenience and greenness. The power button of most computers can also be configured to send the computer into standby mode rather than shutting it down, further enabling users to conveniently save power.

- **Hibernate Mode**

The hibernate mode goes one step further than standby mode by completely powering off the computer. Invoking the hibernate mode causes the memory state to be saved onto the hard disk before powering down. When coming out of hibernate mode, the computer restores the memory state, returning the computer to its pre-hibernate state. A desktop computer will consume approximately *3 watts in hibernate mode vs. 5 watts for standby*. A disadvantage of the hibernate mode is that it takes slightly longer to enter and exit hibernate than standby, the result of saving and restoring the memory state to and from the disk.

Purchase Efficient Devices

Inevitably, a computer will need replacement. When purchasing a new computer, special attention should be paid to several criteria. First, the computer should be energy efficient, following a compliance standard such as *Energy Star*, indicating a recognized conformance to low energy use goals. Second, the manufacturer of the new computer should have a recycling program for used computers to reduce waste. Third, the computers themselves should be made up of as few toxic materials as possible. Clearly, exposure to toxic materials can be detrimental to human health and to the environment.

Reducing Paper Waste

Rather than creating a paperless office, computer use has vastly increased paper consumption and paper waste. Here are some suggestions for reducing waste:

- Print as little as possible. Review and modify documents on the screen and use print preview. Minimize the number of hard copies and paper drafts you make.

- Instead of printing, save information to disk.

- Recycle waste paper.

- Buy and use recycled paper in your printers and copiers. From an environmental point of view the best recycled paper

is 100 percent post-consumer recycled content.

- Do not print out un-necessary e-mail messages.

- Use e-mail instead of faxes or send faxes directly from your computer to eliminate the need for a paper copy.

- Before recycling paper, which has print on only one side, set it aside for use as scrap paper or for printing drafts.

- When general information-type documents must be shared within an office, try circulating them instead of making an individual copy for each person. This can also be done easily by e-mail.

While a user is waiting to replace more expensive equipment, he can reduce paper use by printing double-sided pages, and he can purchase refillable printer-ink cartridges. Small steps, but taken in large measure, can lead to a cleaner planet.

CONCLUSION

The challenges of green IT is immense; however, recent developments indicate that the IT industry has the will and conviction to tackle our environmental issues head-on. Companies can benefit by taking these challenges as strategic opportunities. The IT sector and users must develop a positive attitude toward addressing environmental concerns and adopt forward-looking, green-friendly policies and practices.

Green IT is a hot topic today and will continue to be an important issue for several years to come. 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 in case of even 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 possibly contain the entire feature to save energy and protect our environment and health. The green computer will be the product of years of improvements over its previous models.

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