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A Study on Green Computing:
The Future Computing and Eco-Friendly Technology

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Abstract:
Green computing is the environmentally responsible and eco-friendly use of computers and their resources. In broader terms, it is also defined as the study of designing, manufacturing/engineering, using and disposing of computing devices in a way that reduces their environmental impact.
Many IT manufacturers and vendors are continuously investing in designing energy efficient computing devices, reducing the use of dangerous materials and encouraging the recyclability of digital devices and paper. Green computing practices came into being in 1992, when the Environmental Protection Agency (EPA) launched the Energy Star program.
Green computing is also known as green information technology (green IT).
Government regulatory authorities also actively work to promote green computing concepts by introducing several voluntary programs and regulations for their enforcement.
In this research paper we concern about the Green computing, its needs and steps towards Green computing by a common man. The study emphasis on Benefits of Green Computing, Features of a Green Computer and various Green Technologies are discussed to "Save the Environment, Save Your Life".

Keywords: Green Computing, E- Waste, Environment, Carbon Free Computing, Eco-Friendly Technology.

1. Introduction

Green computing refers to environmentally sustainable computing or IT. Green computing is "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.

Figure 1

2. What Is Green Computing?

The term "green" has always been associated with the name of something that is inclined towards the "nature" or something that has to do with the beneficiary of the environment. Green is used in everyday language to refer to environmentally sustainable activities. LMID developed a working definition of green activities that is both rigorous and flexible. The green is defined more fully in –

- ➢ G - Generating and storing renewable energy
- ➢ R - Recycling existing materials
- ➢ E - Energy efficient product manufacturing, distribution, construction, installation and maintenance
- ➢ E - Education, compliance and awareness
- ➢ N - Natural and sustainable product manufacturing

The term Computing gives you power to imagine new ways of improving our lives by putting better ideas into actual practice in our communities and make a world of difference – reducing energy consumption, enhancing security, reducing pollution, and advancing learning and education. "Green computing encompasses policies, procedures, and personal computing practices associated with any use of information technology (IT). People employing sustainable or green computing practices strive to minimize greenhouse gases and waste, while increasing the cost effectiveness of IT, such as computers, local area networks and data centre "Green computing is all about using computers but in a smarter and eco-friendly way. More directly it means using computers in ways that save the environment, save energy and save money.

3. Technologies of Green Computing

VIA Technologies, a Taiwanese company that manufacture motherboard chipsets, CPUs, and other computer hardware, introduced its initiative for "green computing" in 2001 with this green vision, the company has been focusing on power efficiency thought the design and manufacturing process of its products. Its environmentally friendly products are manufactured using a range of clean- computing strategies and the company is striving to educate markets on the benefits of green computing for the sake of the environment, as well as productivity and overall user experience

Figure 2

3.1. Carbon-Free Computing

One of the VIA Technologies ideas is to reduce the "Carbon Footprint" of user- the amount of greenhouse gases produced, measured in units of carbon dioxide (CO_2). Green house gases naturally blanket the earth and are responsible for its more or less stable temperature. An increase in the concentration of the main green house. Carbon dioxide, Methane, Nitrous Oxide, and Fluorocarbons is believed to responsible for earth increasing temperature, which could lead to serve floods and droughts, rising sea levels, and other environmental effects, affecting both life and world economy. VIA aims to offers the world first "PC" products certified Carbons free, taking responsibility for the amount of CO_2 they emit. The Company works with environment expects to calculate the electricity used by the device over its lifetime generally three year. From this data, one can conclude how much carbon dioxide the device will emit into the atmosphere during its operation.

Figure 3

3.2. Solar Computing

Amid the international race toward alternative-energy sources, VIA is setting its eyes on the sun, and the company's Solar Computing initiative is a significant part of its green-computing projects. For that purpose, VIA partnered with Motech Industries, one of the largest producers of solar cells worldwide. A solar cell fit VIA's power-efficient silicon, platform, and system technologies and enable the company to develop fully solar-powered devices that are nonpolluting, silent, and highly reliable. Solar cells require very little maintenance throughout their lifetime, and once initial installation costs are covered, they provide energy at virtually no cost. Worldwide production of solar cells has increased rapidly over the last few years; and as more governments begin to recognize the benefits of solar power, and the development of photovoltaic technologies goes on, costs are expected to continue to decline. As part of VIA's ―pc-1‖ initiative, the company established the first-ever solar-powered cyber community center in the South Pacific, powered entirely by solar technology.
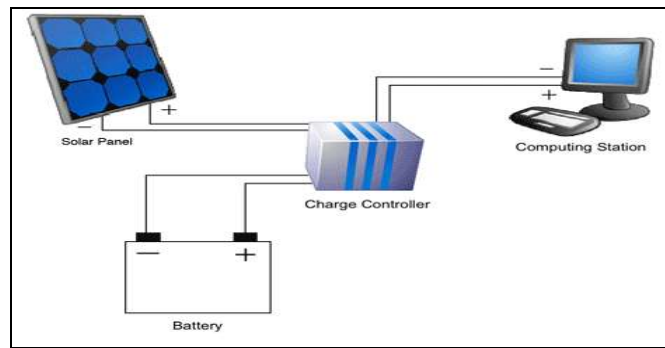

Figure 4

3.3. Energy-Efficient Computing

A Central goal of VIA's green computing initiative is the development of energy-efficient platform for low-power small form factor (SFF) computing devices. In 2005, the company introduced the VIA C7-M and VIA C7 processors that have a maximum power consumption of 1W. These energy-efficient processors produced over four times less carbon during their operations and can be efficiently embedded in solar-powered devices.VIA is not the only company to address environmental concerns Intel is the world largest semiconductor maker, revealed eco-friendly product at recent conference in London. The company users virtualization software, a technique that enables Intel to combine several physical systems into a virtual machine that runs on a single, power base system, thus significantly reducing power consumption. Earlier this year, Intel joined Google, Microsoft and other companies in the launch of the climate saves computing initiative that commits business to meet the environmental protection agency's energy star guidelines for energy-efficient devices.
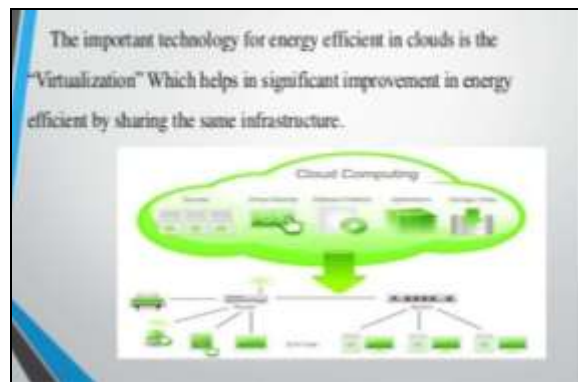

Figure 5

4. Creating Green Environment

Green computing represents a responsible way to save lot of energy and secure our environment from the harmful impacts of computers and its devices. Computer are used everywhere and everybody use it for their convenience. But no one is aware about the harmful impacts of the use of computer on environment. The current trends of green computing are towards efficient utilization of resources. Energy is considered as the main resource and the carbon foot prints are considered the major threads to environment. Therefore, the emphasis is to reduce the energy utilization and carbon footprints and increase the performance of computing. There are several areas where researchers are putting lots of efforts to achieve secure environment results.

4.1. Energy Consumption Organizations are realizing that the source and amount of their energy consumption significantly contributes to greenhouse gas emissions. In response to this finding, organizations are currently using the fallowing equation: Reduced greenhouse gas emissions = Reduced energy consumption = Reduced operational costs for the data center =
It means adopting fewer and more energy efficient systems while re factoring application environment to make optimal use of physical resources is the best architectural model. According to environmental protection agency in around 30% to 40% of personal computers are kept 'ON' after office hours and during the weekend and even around 90% of those computers are idle.

4.2. Virtualization One of the main trends of green computing is virtualization of computer resources. Abstraction of computer resources, such as the running two or more logical computer systems on one set of physical hardware is called virtualization. Virtualization is a trend of green computing it offers virtualization software as well as management software for virtualization environment. One of the best ways to go towards green and save enough space, enough resources and the environment is by streamlining efficiency with virtualization. This form of green computing will lead to serves consolidation and enhance computer security. Virtualization allows full utilization of computer resources and benefit in reduction of total amount of hardware, power off idle virtual server to save resources and energy, reduction in total space, air and rent requirements ultimately reduces the cost.

4.3. IT products and Eco- Labeling another approach to promote green computing and save environment is to introduce polices all around the world, so that companies design products to receive the eco-label. There are several organizations in the world which support "Eco-Label" IT products. These organizations provide certificates to IT products based on factors including design for recycling, recycling system, noise energy consumption etc

5. Five Steps to Green Computing
There are five steps you can take toward a green computing strategy:-

5.1. Develop a sustainable green computing plan Discuss with your business leaders the elements that should be factored into such a plan, including organizational policies and checklists. Such a plan should include recycling policies, recommendations for disposal of used equipment, government guidelines and recommendations for purchasing green computer equipment. Green computing best practices and policies should cover power usage, reduction of paper consumption, as well as recommendations for new equipment and recycling old machines. Organizational policies should include communication and implementation.

5.2. Recycle
Discard used or unwanted electronic equipment in a convenient and environmentally responsible manner. Computers have toxin metals and pollutants that can emit harmful emissions into the environment. Never discard computers in a landfill. Recycle them instead through manufacturer programs such as HP's Planet Partners recycling service or recycling facilities in your community. Or donate still-working computers to a non-profit agency.

5.3. Make environmentally sound purchase decisions Purchase Electronic Product Environmental Assessment Tool registered products. EPEAT is a procurement tool promoted by the nonprofit Green Electronics Council to: •Help institutional purchasers evaluate, compare and select desktop computers, notebooks and monitors based on environmental attributes •Provide a clear, consistent set of performance criteria for the design of products •Recognize manufacturer efforts to reduce the environmental impact of products by reducing or eliminating environmentally sensitive materials, designing for longevity and reducing packaging materials All EPEAT-registered products must meet minimum requirements in eight areas of environmental impact and be energy efficient to reduce emissions of climate-changing greenhouse gases. To demonstrate corporate social and environmental performance, manufacturers must offer safe end-of-life management and recycling options when products become unusable. "Developing environmentally sound products has long been a priority for HP's design and engineering teams," says Jeri Callaway, vice president and general manager, Americas Commercial Solutions, Personal Systems Group, HP. "We're particularly proud that our business-class products already meet, and in some cases exceed, the basic EPEAT standards without any alteration to their existing design."

5.4. Reduce Paper Consumption there are many easy, obvious ways to reduce paper consumption: e-mail, electronic archiving, use the "track changes" feature in electronic documents, rather than redline corrections on paper. When you do print out documents, make sure to use both sides of the paper, recycle regularly, use smaller fonts and margins, and selectively print required pages.

5.5. Conserve energy Turn off your computer when you know you won't use it for an extended period of time. Turn on power management features during shorter periods of inactivity. Power management allows monitors and computers to enter low-power states when sitting idle. By simply hitting the keyboard or moving the mouse, the computer or monitors awakens from its low power sleep mode in seconds. Power management tactics can save energy and help protect the environment.

6. Future of Green Computing
The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings. That is enterprise wise companies are laying emphasis on moving towards Eco-friendly Components in

computers, the use of eco friendly sustainable components will become the norm rather than the exception in future. To this approach for an instance a Canadian Company, Useful Inc. have come up with a solution that turns 1 computer into 10 Discover Station. Quickly becoming the standard for green computing worldwide, Discover Station leverages the unused computing power of modern PC's to create an environmentally efficient alternative to traditional desktop computing. Multiple users can work on a single computer by simply. It is estimated that out of $250 billion per year spent on powering computers worldwide only about 15% of that power is spent computing the rest is wasted idling. Thus, energy saved on computer hardware and computing will equate tonnes of carbon emissions saved per year. Taking into consideration the popular use of information technology industry, it has to lead a revolution of sorts by turning green in a manner no industry has ever done before. Opportunities lie in green technology like never before in history and organizations are seeing it as a way to create new profit centres while trying to help the environmental cause. The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings. Faster processors historically use more power. Inefficient CPU's are a double hit because they both use too much power themselves and their waste heat increases air conditioning needs, 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 high temperatures. Many people have been working for years to lice this inefficiency out of computers. Similarly, power supplies are notoriously bad, generally as little as 7% efficient. And since everything in a computer runs off the power supply, nothing can be efficient without a good power supply. Recent inventions of power supply are helping fix this by running at 80% efficiency or better.

7. Conclusion

Adopting Green Computing Strategies make sense not only from an ethical, or moral stand-point, but from a commercial stand-point. There are many business benefits achievable through the implementation of a green computing strategy such as cost savings, resilience, disaster recovery, business continuity planning and of course public relations. Given the prolific nature of IT within today's information economy IT leaders have an excellent opportunity to significantly impact the fight against global warming, whilst enhancing the business operation and efficiency.

Switching over to green technology doesn't have to be a sudden and unnerving step for authorities. 'Being Green' should be understood as a long-term commitment that solves the purpose of creating a greener and sustainable infrastructure. Many organizations have already started displaying figures of the amount of money they have saved in a calendar year by adopting practical, greener methods. Organizations which are new to 'Being Green' should seek the help of such successful models to establish a list of measures that are most appropriate for their respective.

So Green computing is the utmost requirement to protect environment and save energy along with operational expenses in today's increasingly competitive world.

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