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AN INSIGHT INTO GREEN COMPUTING

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Abstract

In this research article, we present a brief overview of Green Computing. Green computing aims 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 factory waste. In past few years, computer and IT industry have realized the importance of going green, both in terms of environmental issues and minimizing costs which has led to remarkable drift in strategies and policies of IT industry. The motivation behind this change comes from the ever increasing business computing demand, ever growing cost of energy, rising awareness of global warming issues. This research article presses upon Environmental Considerations which focuses on need of green computing in general with respect to electronic devices in use and when they are being disposed off giving birth to e-waste and pollution, areas where green computing is highly demanded with respect to cost and energy savings and Initiatives by governments and corporate sectors in this direction.

Keywords: *Green computing, e-waste, internet of things, data centers*

Introduction to Green Computing

Green computing, Green ICT as per IFG International Federation of Green ICT and IFG Standard, green IT, or ICT sustainability, is the study and practice of environmentally sustainable computing or IT. Murugesan lays out the following four paths along which he believes the environmental effects of computing should be addressed:

1. Green Use 2. Green Disposal 3. Green Design: Green Manufacturing: Manufacturing electronic components, computers and other associated sub systems with minimal impact or no impact on the environment. [1] [2]. A green computer or green IT system is one where the entire process from design, manufacture, use, and disposal involves as little environmental impact as possible. In other words, a green initiative is taken in consideration of all facets of a computer's life, from design to disposal.

Why Green Computing

The first thing that hits our mind is because it is the need of the hour. Global warming which has been the major disease since it came into light, poses threats for the future. We are in an

era where needs and demands are growing by second of the clock. Resources are limited and they should be managed in such a way that our future has some silver linings to it. [3]. This paper has been divided into three sections (a) **Environmental Considerations** which focuses on need of green computing in general with respect to electronic devices in use and when they are being disposed off giving birth to e-waste and pollution. Section (b) focuses on areas **where green computing is highly demanded with respect to cost and energy savings** and (c) **Initiatives by governments and corporate sectors in this direction**.

A. *Environmental considerations*

Many of the technologies we use every day consume a lot more resources and power than they need to, and using and manufacturing them can create a mess. Energy use comes from electrical current to run the CPU, motherboard, memory running the fan and spinning the disk(s) monitor. (CRTs consume more power than any other computer component). Printers computer energy is often wasteful leaving the computer on when not in use. There are toxic chemicals used in the manufacturing of computers and components which can enter the food chain and water. Chemical Elements Found in Computers and Components.

- Elements in bulk: lead, tin, copper, silicon, carbon, iron and aluminum.
- Elements in small amounts: cadmium and mercury
- Elements in trace amounts: germanium, gallium, barium, nickel, tantalum, indium, vanadium, terbium, beryllium, gold, europium, titanium, ruthenium, cobalt, palladium, manganese, silver, antimony, bismuth, selenium, niobium, yttrium, rhodium, platinum, arsenic, lithium, boron, americium.

Devices containing these elements almost all electronics contain lead & tin (as solder) and copper (as wire & PCB tracks), though the use of lead-free solder is now spreading rapidly lead: solder, CRT monitors (Lead in glass), Lead-acid battery. Another problem which is faced with respect to environment and management is disposal of the e-waste.

Fig. 1: E-Waste

Disposal of the electronic devices constituted 20-50 million tons per year (about 5% of the total waste of the planet). Europe has outlawed using landfills for computer components the US and Europe export a lot of e-waste to Asian landfills (especially China even though China has outlawed the importing of e-waste) in addition, incineration of computer components leads to air pollution and airborne toxins.

1. *Steps towards solution*

Reuse, Refurbish and Recycling

Government regulatory authorities also actively work to promote green computing concepts by introducing several voluntary programs and regulations for their enforcement.

Average computer users can employ the following general tactics to make their computing usage greener:

- Use the hibernate or sleep mode
- Use flat-screen or LCD monitors,
- Buy energy efficient notebook
- Activate the power management features

2. *Industry understands responsibility*

Companies which manufacture electronic products also work for solutions for environmental preservations. Nokia, Dell, Sony, Ericsson, Motorola but top of the list is acquired by VIA Technologies. VIA Technologies, a Taiwanese company that manufactures 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 throughout the design and manufacturing process of its products. [4].

Numerous efforts have been put into by many companies in this respect and have been able to obtain quality results [5] [6] for more detailed information [7].

B. *Areas of focus where green computing is highly demanded*

1. *Green Servers and Data centers*

In a world where business is transacted 24/7 across every possible channel available, companies need to collect, store, track and analyze enormous volumes of data—everything from click stream data and event logs to mobile call records and more. But this all comes with a cost to both businesses and the environment. As data volumes explode, traditional, appliance-centric data warehousing approaches can only continue to throw more hardware at the problem. This can quickly negate any green gains seen through better cooling or more

tightly packed servers. To minimize their hardware footprint, organizations also need to shrink their "data footprint" by addressing how much server space and resources their information analysis requires in the first place [8].

Fig. 2: Data Center near Arctic Circle

For many of the technology giants, one of the biggest costs they face is in maintaining data centers. For companies like Google, Facebook organizing the world's information comes at the high cost of running some of the largest, most sophisticated data centers in the world. Energy use is one of their biggest operational expenses for many of these companies. This creates an alignment of environmental and business interests for companies like Google and Facebook, who are finding innovative ways to reduce their energy consumption.

Google is incredibly active in creating efficient data centers, maintaining tight control of all their operation.

A recent survey report shows that this industry uses almost 3-percent of the world's energy. Data center companies may opt to trim down the idle and unused servers. Alternatively, they may also embrace measures that reduce energy consumption such as exploiting renewable energy like: Geothermal Energy, Solar Energy, Wind Energy, Recycling Heat. [9]

2. *Internet of Things goes green*

Internet of Things (IoT) is innovation in the field of Communication where a number of intelligent devices are involved sharing information and making collaborative decision. IOT is going to be a market-changing force for a wide variety of real-time monitoring applications, such as E-healthcare, homes automation system, environmental monitoring and industrial automation as it is supporting to a large number of characteristics and achieving better cost efficiency.[10]

Fig. 3: Internet of things

It is expected that the Internet of things will become a reality over the next 20 years; with omnipresent smart devices wirelessly communicating over hybrid and ad-hoc networks of devices, sensors and actuators working in synergy to improve the quality of our lives and in synergy to improve the quality of our lives and consistently reducing the ecological impact of mankind on the planet. [11]. Also throw light on ongoing and intensified research in this area.

3. *Green Cloud Computing*

According to market research conducted by Pike Research, the wide-spread adoption of cloud computing could lead to a potential 38% reduction in worldwide data center energy expenditures by 2020. The savings would be primarily achieved by consolidating data centers and maximizing power usage efficiency (PUE), improving recycling efforts, lowering carbon and gas emissions and minimizing water usage in cooling the remaining centers. Because so much of a data center's energy expenditures support data storage, the Storage Networking Industry Association (SNIA) has promoted new technologies and architectures to help save energy. It is forecasted that the environmental footprint from data centers will triple between 2002 and 2020, which is currently 7.8 billion tons of CO_2 per year. Garg and Bhuva also presented solution oriented measures to meet the challenges in green cloud computing. [13].

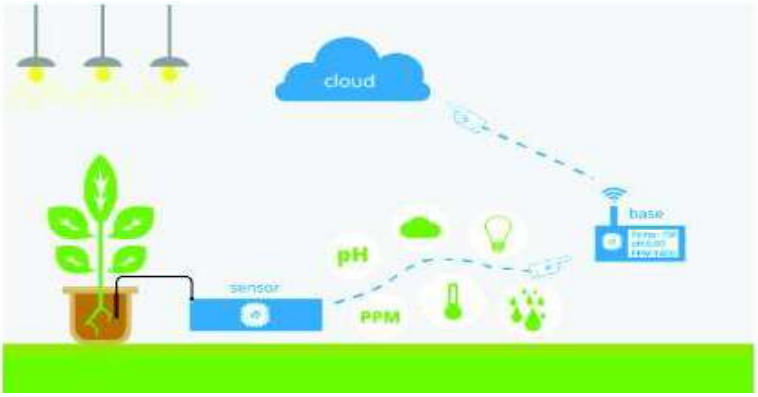

Fig. 4: Making cloud eco friendly

It is pertinent to mention here that green cloud computing comes with enormous benefits. Vivek, Bala [14] throw light on various benefits in GCC some

of them are Reduced Cost, Automatic Updates, Remote Access Disaster etc.

C. *Initiatives by Governments and corporate sector*

Many governments worldwide have initiated energy-management programs, such as Energy Star, an international standard for energy-efficient electronic equipment that was created by the United States Environmental Protection Agency in 1992 and has now been adopted by several other countries.

In 1998, the China National Development and Reform Commission (NDRC) founded the China Energy Conservation Program (CECP), a nonprofit organization in charge of the administration, management, and implementation of the certification for energy-conserving, water-saving, and environmentally friendly products. [15]

In May 2006 Ministry of power Govt. of India formally launched the standards and labeling scheme for adoption of section 14 of energy conservation act 2001 (52) of 2001, since then bureau of energy efficiency has been promoting and facilitating its adoption.[16]

U.S. federal government increases commitment to EPEAT green computing. In another step to ensure that all Federal agencies purchase and use the 'greenest' computers available, the U.S. federal government has integrated a requirement for use of EPEAT (the Electronic Product Environmental Assessment Tool) into the Federal Acquisition Regulations (FAR) [17]

1. Going Green at Work

Organizations all over the world are beginning to understand their corporate social responsibility toward the environment. Organizations must follow these simple steps for creating the green computing awareness in their workplaces.

- Announcing green intentions to all employees, Setting up a committee to form a green IT plan, Centralization of all desktops, Using efficient computer applications, Power management tactics, Business performance enhancement.

The most common actions organizations have undertaken are: Virtualization, Power Saving, Telecommuting, etc. VoIP. [18] In May 2007, IBM unveiled its *Project Big Green*, dedicated to increasing energy efficiency across the company's branches around the world. . Zonbu is the first company to introduce a completely environmentally responsible computer thanks to a low-power design and regulatory-grade carbon offsets. The device, which complies both to Energy Star standards and the Restriction of Hazardous Substances Directive (RoHS), consumes only 15W, compared to the 175W consumed by a typical desktop PC. Zonbu also provides a free take-back program to minimize environmental e-waste. Another American

company, Everex, has released the Impact GC3502, a green PC that uses 20W of power, owing to a 1.5GHz VIA C7-D processor [15].

Conclusion

The intension behind writing this article is to support the idea of environment protection for upcoming generations and to highlight the fact that the smart world will not exist without optimal usage of resources and energy. New computing innovations and applications need to fulfill the green computing requirements for the sustainable development of Information and communication technology (ICT). As discussed in section A of this paper green computing is our responsibility. Every ICT user has to understand and take preventive measure to use devices and services very efficiently and contribute minimum to e-waste. In addition, regulatory agencies are making positive moves to stem a rising tide of e-waste. Meanwhile, technology continues to yield solutions with greater energy and material efficiency. Based on the growth of the industry, the power needs are increasing and thus there is a need to monitor the power usage. As the power needs increase, more earth-friendly measures can to be taken to help the environment. Also, the management and administrators need to discuss the increasing needs of the data centers.

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