



Green Computing: A Review

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Abstract:- Today computers are used in every field of life, whether it is educational, banking, business, medical, research etc. We cannot think of life without computers. We know that every stage of computer life starting from the production, use and disposal cause environmental problems. Green Computing or Green IT refers to the practice and procedures of using computing resources in an eco-friendly way. It is the practice of using energy prudently and efficiently so that it causes negligible degradation to the environment. Green computing also concerns to aware the people to take necessary individual steps to create healthier, safer and clean environment without compromising technological needs of the current and future generations. This paper presents the need of green computing and approaches.

Keywords: Green Computing, Environment, Green House Gases

1. INTRODUCTION

1.1 What is Green Computing?

Green computing practices came into existence in 1992, when the Energy Star program launched by the Environmental Protection Agency (EPA) to promote the energy efficient hardware of all kinds. According to Dr. San Murugesan[2] a senior consultant, Green IT "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." In other words 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.

This technology is beneficial the following ways:-

- Computing resources work energy efficiently during peak time.
- Energy consumption of computing resources is reduced.
- Energy saving during idle operation
- Use of Eco-friendly sources of energy
- Harmful effects of computing resources is reduced
- Reduce computing wastes
- Better Resource Utilization
- Significant reduction in total operational costs as resources is utilized efficiently.

1.2 Need of Green Computing

If we think computers are non polluting and consume very little energy we need to think again. Widespread use of

computers and related IT products has a very bad effect on the environment.

Over 70% of the computing power is not utilized and more than 50% of the electrical energy used by the computing devices is wasted and dissipated as heat. This energy will contribute to the carbon emissions. As we know greenhouse gases are having a devastating and long lasting harmful effect on our atmosphere and environment. The world's climate and weather patterns are changing in an alarming way due to continuing accumulation of green house gases. Global atmospheric temperature is also slowly increasing due to accumulation of greenhouse gases. Storms, droughts, and other weather-related disasters occur more frequently and more severe due to this increase in global temperature. Electricity also plays the major role in climate change. As we know that major part of electricity is generated by thermal plants. During the process of electricity generation huge amount of carbon-dioxide and other harmful particles are released into the atmosphere. Producing electricity in eco-friendly way and reducing the electrical consumption, this situation can be controlled in some level. These emissions cause serious respiratory diseases, smog, acid rain and global climate change. The sea-level is also increasing alarmingly because due to global warming glaciers are melting as never before. So, we can say today, it is the need of the hour to take some steps to reduce the emissions of green house gases and safeguard our environment [2].

2. IT AND ENVIRONMENT

Every stage of a computer's life, starting from its manufacturing, throughout its use, and its disposal, poses environmental problems. During manufacturing of IT equipment's and their parts hazardous waste is generated. For examples production of semi conductors releases dangerous gases into the atmosphere such as acid fumes. Also only 2% material used in the production of personal computers becomes part of the product and 98% is dumped as waste [3].

Components used for the production of IT equipment come from different places from all over the world. These components send to assembly centers and then final product is exported to other places. The transportation process leaves a significant amount of footprint.

Another impact is the consumption of energy by the ICT equipment. The total electrical energy consumption by servers, computers, monitors, data communication

equipment's, and cooling systems for data centers is increasing at a very fast rate. These increase in energy consumption results in increased greenhouse gas emissions. Each PC in use generates about a ton of carbon dioxide every year.

E-waste also effects the environment badly. E-waste comprises of old and outdated electronic devices. These devices are disposed off to buy new and more advanced equipment's. Computer components contain lot of toxic materials. Improper e-waste management led to pollution due to leakage of lead, mercury or other toxic material from the e-waste to the land-fills. Cathode ray tubes (CRT) if leaked will release heavy metal leaching to the ground water and harm the water source. It is our collective responsibility to safeguard our environment from these bad impacts of the IT.

3. ENERGY EFFICIENT COMPUTING PRACTICES

Energy efficient computing is the practice of using computing devices, with keeping in mind energy saving and productive utilization. Some practices that should be adopted by an individual or an organization are:

- Always try to purchase energy efficient i.e. energy star labeled products. Energy star label indicates the energy efficiency of the appliance such as TV, monitors, printers, Air Conditioners and other household appliances, which goes between one and ten stars. The greater the number of stars the higher the efficiency.
- Turn off your computer and/or peripheral when they are not in use. Or put them into sleep mode. When placed in sleep mode, the computer cuts power to unneeded subsystems and places the RAM into a minimum power state, just sufficient to retain its data. In sleep mode energy consumption is reduced to great extent.
- Power down the CPU and other peripherals they are not in use for long time.
- Look for ways to reduce the amount of time your computer is on without adversely affecting your productivity.
- Do not turn on all your computer equipment as soon as you enter the office each day unless you need it.
- Try to group computer related activities and do in intensive parts of the day leaving the computers off at other times.
- Switch on energy intensive peripherals such as laser printers according to need.
- LCD monitors are up to 66% more energy efficient than CRTs so use LCD monitors rather than CRT.
- Inkjet printers use 80%-90% less energy than laser printers with better printing quality. So prefer to buy inkjet printer.
- If monitors on the servers are not needed to operate, keep server monitors off. If server monitor is needed during the day, at least turn off at night and weekends.
- Use notebook computer rather than desktop whenever possible.

- Reduce Paper Waste: Print as little as possible and recycle waste paper.
- Reusing and Recycling of Hardware Devices.

4. APPROACHES FOR GREEN COMPUTING

4.1 Data Center Virtualization

Due to rising use of Internet and Web applications, demand for the information storage (data centers) increasing rapidly. Companies are installing more and more servers to expand their capacity. Data center facilities are heavy consumers of energy, accounting for between 1.1% and 1.5% of the world's total energy []. Operational costs of data centers are also heavy. Energy efficient data center design should address all of the energy use aspects included in a data center: from the IT equipment to the HVAC equipment to the actual location, configuration and construction of the building. Data center efficiency can be improved by using new energy-efficient equipment, improving airflow management to reduce cooling requirements, investing in energy management software, and adopting environmentally friendly designs. Effective approach for cooling data centers include raised floors to improve airflow, moving cooling systems closer to servers to concentrate cold air in the right place, alternating hot and cool server passageway to improve airflow and using water-based air conditioning systems. Energy efficient data center design should help to better utilize a data center's space, and increase performance and efficiency.

With virtualization, several physical systems can be combined into virtual machines on one single, powerful system, thereby unplugging the original hardware and reducing power and cooling consumption. The server administrator uses a software application to divide one physical server into multiple isolated virtual environments. It helps in distributing work so that servers are either busy or put in a low-power sleep state. By virtualizing data center an efficient, responsive IT environment can be created.

- Improve asset utilization
- Lower capital and power and cooling costs
- Reduce management touch points
- Accelerate IT service delivery

4.2 NComputing

NComputing systems are a major leap forward in green computing. Today more than 15,000 organizations in over 80 countries have used NComputing to reduce their carbon footprint and electric consumption. NComputing is a desktop virtualization company that manufactures hardware and software to create virtual desktops (thin clients) which enable multiple users to simultaneously share a single operating system instance. It is based on the fact that majority of applications on PC only use a small fraction of the computer's capacity. NComputing's virtualization software and hardware utilizes this unused capacity so that it can be simultaneously shared by multiple users. The NComputing virtualization software works on a standard

Windows or Linux PC. Each employee should be provided with virtual desktop(thin client) that includes a mouse, keyboard and screen while the remaining unit is shared by all at a central location through a small and durable NComputing access device. The device itself has no CPU, memory, or moving parts—so it is easy to deploy and maintain. It also consumes very little power [4].

4.3 Alternative Storage Methods

Storage drives are another main element of data center infrastructure and, as organizations storage needs increase; more energy is used to power these hard drives. It can be reduced by using large capacity drives and performing data center audits to eliminate redundancies in the system.

4.4 Printers Output Management

Centrally located printer may be used to handle all printing tasks eliminating numerous machines being left on all day sucking up energy and driving up costs.

4.5 Recycle and Reuse

Computer recycling refers to recycling or reuse of a computer or electronic waste. Computers have toxin metals such as lead, mercury, and hexavalent chromium and pollutants that can emit harmful emissions into the environment. Never discard computers in a landfill. Recycle them through certain retail outlets and municipal or private recycling centers or donate still-working computers to a non-profit agency. Recycling computing equipment can keep harmful materials out of landfills. Computing supplies, such as printer cartridges, paper, and batteries may be recycled as well.

4.6 Telecommuting

Telecommuting is the work arrangement in which employees can do work from their home i.e. they do not need to travel to their work place. Telecommuting is facilitated by tools such as teleconferencing, virtual call

centers, virtual private networks and voice over IP (VOIP). It is efficient and cost effective as it saves significant amount of travel time and cost. It also reduces impact on the environment by reducing greenhouse gas emissions related to travel and fuel usage.

5. CONCLUSION

Today we use computers almost in every field of our life. It is penetrating into our lives at an amazing rate. Use of this causes positive as well as negative impacts on our society and environment. To protect our environment from the harmful effects of the IT (Which we discussed above) is the need of the hour, for that we should take action collectively and try to adopt green computing procedures throughout the life cycle of computer to safeguard our environment.

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