

GREEN COMPUTING - AN ANALYSIS OF ENERGY CONSUMPTION AND CARBON FOOTPRINT OF COMPUTING SYSTEMS

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ABSTRACT

Green computing technology looks for the efficient utilization of computing resources. Utilization of energy in the computing systems like PCs, Laptop, Cell Phones and Data Centres is one of the important needs today, as 3% of the total Carbon dioxide footprint is produced from IT sector. The objective of this article is to evaluate and measure the energy expended every day by various computing devices resulting in the emission of carbon dioxide.

I Introduction

Green Computing refers to the analysis of designing, developing, manufacturing, consuming and later scrapping of personal computers, high capacity servers and their sub-systems. Green Computing makes users aware how efficiently the computing resources can be used. Green computing is a necessity now because Carbon dioxide emitted by computing system contributes to global warming. It has been observed that around 3% of the total carbon dioxide footprint is generated from IT sector. As there is rise in the global warming resulting in unpredictable climatic changes it has become imperative to develop algorithms and techniques that are energy efficient. High usage of energy by computing systems generate more heat releasing carbon dioxide from data centers.

II Review of Literature

In [1], the author has presented various green initiatives which are necessary in the computer industry to achieve energy efficiency. He has stated that the study of efficient and eco-friendly computing resources is under the consideration of environmental organizations and businesses from other

industries. He contends that IT Sector companies have realized that going green is in their best interest, apart from benefitting the environment and reducing cost.

In [2], authors talk of reducing the heat generated by the datacenters in the IT industry with a new power-saving algorithm. The proposed algorithm will not only reduce the emission of carbon dioxide but also the cost of energy.

In [3], author has reviewed the origin of the Green Computing. Then evaluation and analysis were done on the principles of Green Computing, and an evaluation of index system of systems of Green Computing systems was also done. He has also proposed a process for evaluation of Green Computing system.

III Energy Consumption and Carbon dioxide emission rate by Computing Systems

As indicated by the ecological security organization, nearly 30% to 40% of Personal Computers are kept ON during weekends, and even after working hours nearly 90% of these PCs remain ON and inactive. A lot of power is consumed by the Data Centers and for cooling the office resulting in the release of more heat and carbon dioxide. So, the computing systems should have power efficient design at all the four levels such as virtualization, hardware, data center and operating system. Cooling system is needed as more and more power is consumed and a lot of heat is dissipated. Therefore, power bills become huge since various power delivering facilities like power distribution units and uninterrupted power supplies are required round the clock. Table 1 shows the rates of electricity consumption and carbon dioxide in computing systems. From the table it is clear that data center is a heavy consumer of energy, and the emission of Carbon dioxide is also more. Several initiatives

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are taken by the government and industries to reduce electric power consumption.

Computing Systems	Carbon dioxide Emission Rate	Electricity Consumption
Data Centres	200 million metric tons	90 billion kilowatt
Laptop	88 kg	150 and 300 kWh
PC's	69,2.05 kg	400 kilowatts / hour
Smartphone	16kg	2 to 6 watts

Table 1: Electricity Consumption Rate and Carbon dioxide Emission Rate of Computing Systems

IV Managing Computing Systems Intelligently

PCs can be placed in sleep or hibernation mode to save energy, when they are not in use for a long time. While users go to sleep at night, the computers shall be switched off [4]. Different Power management features can be used for reducing the consumption of energy. It is good to purchase a laptop rather than a desktop. For reducing the power consumption by CPU, various power-saving algorithms and methods can be applied along with the technique of dynamic voltage and frequency[5].

Carbon-saving is offered by land lines, for transmitting a call over a fixed land line, where only one third of the power of a mobile call is required. Sustainable materials are used for making smart phones and construction is modular. When something goes wrong in a phone, instead of replacing the phone itself a faulty part, or parts, in it can be replaced[6].

Virtualization is the process by which utilization of resources can be improved by minimizing the amount of hardware that is being used in a computing environment, which in turn leads to less consumption of power[7]. For implementing virtualization, many virtual Machines have to be created on a physical server. Combining of work load into very least of physical resources and turning off the resources that are idle will help to conserve energy reducing the cost of ownership.

Introduction of software bots can save human effort and consumption of energy. Bots can support enormous savings in the green world by reducing travel between home and

workplace, reduction in water and other utility usages in workplaces and reducing usage of energy[8].

Reuse of Electronic equipment can contribute a lot to improve energy efficiency and can reduce the impact on the environment. For example, reuse of materials like tin, silicon, aluminum, lead and mercury can be resorted to in the development of PC equipment.

Energy efficiency and maintainability objectives can be achieved by moving from a conventional framework to cloud-based framework. Merits of Cloud are Scale up/Downsize limit and pay-per-use[10]. The pay-per-use of cloud-based administration gives resource-efficiency and energy simultaneously.

V Conclusion

With the increase in global warming and unexpected changes in climate, the major concern now is to develop and adopt algorithms and techniques that are energy-efficient. New ways and methods are being developed to optimize the computing environments. While humans coexist with robots, greener world can be made.

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