

Study of Carbon Emission in Computing Scenario

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Abstract - This paper presents a case study of what is green computing, why we need to go green computing & will tell you how to minimize the energy consumption as well how to lessen the CO₂ emission by going Green Computing. The huge amount of computing manufactured worldwide has a direct impact on environment issues and scientists are conducting numerous studies in order to reduce the negative impact of computing technology on environment. Energy consumption in the datacenter reached the highs. A large corporate IT infrastructure, consumes as much as the energy produced by five power plants over the same time period. This case study will provide a rich source for anyone interested in green computing research.

Keywords- virtualization, cloud computing, hibernation, green computing.

I. INTRODUCTION

Green computing is the term used to denote efficient use of resources in computing. This term generally relates to the use of computing resources in conjunction with minimizing environmental impact, maximizing economic viability and ensuring social duties[2],[23].

The trend toward IT centralization and consolidation has created a power surge in the datacenter, with energy costs. It is estimated that for every kilowatt of energy consumed by a server, roughly another kilowatt is used to cool that same server[21]. The cost of energy consumption by IT infrastructure in 2006 in US was estimated as 4.5 billion dollars and it is likely to be double by 2011.[3],[8]. High power consumption by the infrastructure leads to substantial carbon dioxide (CO₂) emissions contributing to the greenhouse effect[4][5].

One of the first manifestations of the green computing movement was the launch of the Energy Star program back in 1992. Energy Star served as a kind of voluntary label awarded to computing products that succeeded in minimizing use of energy while maximizing efficiency [24].

NEED TO GO GREEN COMPUTING

If we want to save our planet and want to make ourselves and surroundings healthy, going green is very much important. Energy to manufacture, store, operate, and cool computing systems has grown significantly in the recent years, mainly due to volume of systems and computing used by companies.

First and foremost, conclusive research shows that CO₂ and other emissions are causing global climate and environmental damage[14],[25].

Green computing can lead to serious cost savings over time. Reductions in energy costs from servers, cooling, and lighting are generating serious savings for many

corporations. As energy demands in the world go up, energy supply is declining or flat. Energy efficient systems help ensure healthy power systems. Data centers have run out of usable power and cooling due to high densities [14].

Data center densities increasing rapidly resulting in consuming enormous amount of electrical power & emitting more greenhouse gases. For example, for a 30,000 sq.ft. 10MW data center with 1000 standard computing racks each consuming 10KW, the annual cost of electricity for the computing equipment alone is likely to be close to \$8 million.[7].

Keeping the energy consumption in mind some large organizations started building zero-carbon datacenters fed by clean hydroelectric power. But this option is not cost-effective for smaller facilities with mid-sized datacenters, it is particularly attractive to high-density computing installations featuring thousands of servers and requiring enormous amounts of power.[21].

WHY SUCH HUGE ENERGY CONSUMPTION OCCURS?

A. Cooling Consideration

Cooling the tremendous amounts of heat generated by computers is essential in order to keep the equipment and the software stable. This cooling in turn requires a significant amount of energy which can be estimated at between 30% to 50% of the energy used to power the hardware[14],[31].

We can reduce energy consumption by concentrating on the initial source of the energy burned in the computer. Energy efficient fans, CPUs, power supplies, disks, and related components can make a big difference that pays huge dividends [32],[33],[34].

B. Algorithmic Impact

The efficiency of algorithms has an impact on the amount of computer resources required for any given computing function and there are many efficiency trade-offs in writing programs.

A typical search generates about 7g of CO₂. Performing two Google searches from a desktop computer can generate about the same amount of CO₂ as boiling a kettle for a cup of tea. Though Google says it produces about 0.2g of CO₂. [15].

Google says it is in the forefront of green computing, its search engine generates high levels of CO₂ because of the way it operates. When you type in a Google search for, say, "energy saving tips," your request doesn't go to just one server. It goes to several competing against each other. It may even be sent to servers thousands of miles apart. Google's infrastructure sends you data from whichever produces the answer fastest. The system minimizes delays but raises energy consumption.[26][27]

More recently, an independent study by Green IT.fr demonstrate that Windows 7 + Office 2010 require 70 times more memory (RAM) than Windows 98 + Office 2000 to write exactly the same text or send exactly the same e-mail than 10 years ago[27].

HOW TO OVERCOME THIS PROBLEM?

Energy efficiency can be achieved by number of ways such as improvement of applications' algorithms, energy efficient hardware, Dynamic Voltage and Frequency Scaling (DVFS) [1], terminal servers and thin clients, and virtualization of computer resources [6].

We can conserve energy by using method for computer systems is the use of Computer Power Management (CPM). If CPM is enabled on a correctly configured system & the system is inactive for some period then CPM causes the computer to go into low power state (Sleep or Hibernate mode)[17]. If CPM is used it can save energy cost by roughly \$50 each year from a single computer, or the CO2 emission saved by one single computer will be equal to one-third ton of CO2. That can be compared to the six standard light bulbs with compact fluorescent[30]. CPM is one of the most beneficial method to reduce the energy consumption.

We can reduce the carbon emission through Cloud Computing also. If cloud computing is used in large companies it can reduce annual carbon emission by 85.7 metric tons by 2020[13], this is equivalent to 200 million barrels of oil, which is enough to power 5.7 million cars for one year[20].

Use of Multi-Core Processors

Multi-core processors can enhance computing without adding significant extra power requirements to the overall systems. Many embedded systems now take advantage of low-power multi-core processors as well. Sun's multicore chips, for example, are leading power efficiency: its 32-thread Niagara 1 chip, UltraSPARC 1, consumes about 60 watts, while the Niagara 2 chips have 64 threads and run at about 80 watts[16]. Furthermore, Sun has integrated most of the peripheral components into the chips as well, further reducing power consumption and e-waste.[14].

Use of virtualized system

In the past, we need to maintain the number of copies of the same data on every computer system but now can be stored once in the shared storage subsystem. Storage virtualization makes it possible for systems to access a shared storage subsystem that is available on the net. This approach will reduce the operational and administrative costs of back up storage, the number of storage devices needed, the amount of power required and the heat produced.[8],[9],[10],[18][35].

Replacement of CRT monitor with LCD or LED monitors

CRT monitors use more energy than LCD monitors. Overall, LCDs can reduce display energy use by some 60%.[19] For example, a 15" LCD uses around 25 watts when operational and around 3 watts when in standby

mode, compared with an equivalent viewing area 17" CRT that uses 80 watts when operational and 5 watts in standby mode[12],[36].

Terminal Server System

We can reduce energy consumption by using terminal server system to connect multiple users to transfer data into a Central Server. No need to process the data on client side the central server will process the data.[2],[28].

Hibernate Mode

Use hibernate mode instead of standby mode[37] or shutdown. Hibernation saves electrical power because After hibernating the hardware is completely powered down, modern machines, even if switched off, often consume a little power allowing them to be woken on an alarm timer, by Wake-on-LAN[11] etc. as well hibernation takes less time to restore all running programs than time taken after shutting down the computer system[22]. Hibernation is often used on laptops, which commonly have limited battery power available, and can usually be set to happen automatically on a low battery alarm. Most desktops also support hibernation, mainly as a general energy saving measure[29].

Reduction in the uses of toxic chemicals such as lead, cadmium, mercury etc. in computer parts[2]. Introduction of recycling programs in all places to dispose obsolete devices easily.[2].

CONCLUSION

We have done the case study for Carbon Emission in Computing Scenario and come to a conclusion that we can reduce the carbon emission & can save energy in our day to day life by using some simple tips.

Turn off the computer immediately after the use. Do not keep it in standby mode.

If devices such as printer, audio system, scanner, modem etc are not using unplug them.

Switch on the UPS only when the computer is using. If you are using the computer for one or two hours daily, that is enough for charging the battery. This prevents overcharging of the battery and reduces the electricity cost.

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