Green Computing

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Abstract--- Green computing or green IT , refers to Environmental sustainable computing or IT. The study and practice of designing , manufacturing disposable computers, servers and associated sub – systems such as monitor, printers, storage devices and networking and communication systems efficiently and effectively with minimal or no impact on the environment. Green computing is the environmentally responsible use of computers and related resources. Such practices include implementation of energy- efficient central processing unit, servers, peripherals as well as reduced resource consumption and proper disposal of electronic waste. One of the earliest initiatives towards green computing in the United States was the voluntary labeling program known as Energy Star. It is conceived by the Environmental Protection Agency (EPA) in 1992 to promote energy efficiency in hardware of all kinds. The Energy Star label became a common sight especially in laptops and displays. Today's PCs are so powerful that the vast majority of applications only use a small fraction of the computer's capacity, it can be simultaneously shared by multiple users. Consumers 90% less energy per user PCs typically consume between 110 to 200 watt light bulb. A class room, computer lab, office with PC's warms up very quickly. PC-filled work areas always have to be air conditioned. Air conditioners raise electricity cost & require large capital expenditures to buy, install and maintain them. Electronic waste is a large & growing problem throughout the world. On a broader scale, the Kyoto Protocol and The Climate Savers Computing Initiative (CSCI)-Global efforts to save the environment which require Active participation of governments, organizers and manufactures. The computers and peripherals draw significant amount of energy in sleep and standby modes. They contribute to harmful CO2 emissions. These days everyone seems to talk about global warming and ways to protect the environment. Unconsciously, all of us are contributing to unwanted CO2 emissions from house through careless use of our electrical devices. According to reports from the German Federal Environment Office, devices consume around 17 billion kilowatts hour (kWh) in a year when They are in standby mode. DVD players, DVD Recorders or even multifunctional printers continue to draw electricity because of the absence remote of an 'OFF' button. If you press the 'Power Off' on the remote, these devices go into standby mode. Windows Vista never shuts down or powers off the PC completely. The default shutdown mode is a deep sleep mode that requires power. Its only when you switch off the main switch at the back of the computer that power supply unit stops drawing power.

I. Introduction

With the increasing concern regarding global climate change and volatility of energy markets, computing has begun to embrace the notion of green information and communication technologies (ICT), in which the environmental impact is the design of new technologies & system. Green ICT is designed to consume less electricity has become a significant concern in the world of computing. The goals is similar to green chemistry that reduces the use of hazardous materials, maximum energy efficiency during the products lifetime and promotes recycling or biodegradability of defunct products and factory waste. The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings. The recycling of old computers raises an important privacy issue. Computer systems that have outlived their particular function can be re-purposed or donated to various charities and non-profit organizations.

A. Approaches To Green Computing:

Energy costs of IT and data center operations are significant, whether for internal corporate IT or as part of IT outsourcing.

B. Virtualization:

Initiatives in this area include server virtualization and consolidation, storage and consolidation and desktop virtualization. These projects typically improve cost and energy efficiency through optimized use of existing and new computing and storage

capacity, electricity, cooling, ventilation and real estate.

II. PC Power Management:

Many look to managing end-user device power consumption as an easy, effective way to reduce energy costs. These power management initiatives include the following:

- Using software that centrally manages energy settings of PCs and monitor
- Enforcing standardized power settings on all PCs before distributing to end users.
- Procuring energy-efficient equipment, such as Energy Star certified devices

III. Framing Of The Carbon Problem

There was a time in the 1980s that some people were quoted as saying that trees caused more pollution than automobiles. By this, they might have meant that emissions of carbon dioxide (CO2) by trees and other flora were significant.. But plants and bodies of water also break down CO2 in a relatively balanced cyclical activity. In contrast, humans produced CO2 (along with other greenhouse gases which many believe to have an effect on the climate), from the production of concrete, running of internal combustion engines or generation of electricity from fossil fuels for example, are not naturally removed and therefore

add to the global atmospheric stores of the gas,

Thus, human generated carbon emissions are out of balance with nature.

IV. MEASURING ICT'S CARBON FOOTPRINT

Given the divergence in estimates in reports both scholarly and popular on the energy element of ICT and after contacting major vendors and market research firms, we concluded that it would be wise to make our own attempt to quantify the energy consumption of the ICT sector, and through this, determine the amount of carbon emitted. The ability to state all the assumptions and computational steps explicitly was on overarching concern that we strived to maintain throughout this exercise. In this way, a reader can either agree or disagree with our assumptions, and thus choose to accept our conclusions with all of the information being readily available. In so doing, we built on the work of others that we believed well grounded. Subsequently, we will use these estimates in the context of the SIQ measure, to relate the national economic growth (measured through the Gross Domestic Product or GDP) to the cost of carbon involved, and thus to the concept of improving efficiencies as a way of enabling a higher ceiling for ICT's contribution to the GDP in the future.

V. ILLUSTRATING OUR METHODOLOGY FOR ENERGY CONSUMPTION OF ICT SECTOR

Let us use the personal computer or PC as a driving example to explain our methodology, which consists of two elements. The first element consists of estimating the number of devices in use for a particular year, called the established base (EB), while the second encompasses an estimate of annual energy consumption (AEC) of each PC. Operating under this assumption, the global annual energy consumption (GAEC) of the PC sector for a particular year may be expressed as :

$$GAECpc = EBpc \times AECpc$$

The annual energy consumption of a PC is estimated by dividing its state into 3 operating modes: active, when the device is on and the processor can be functioning; sleep, when the processor is on a standby mode; and off, when the device is switched off but remains plugged into the electrical socket. The annual energy consumption for a PC in each of these modes can be obtained in turn by multiplying the average power consumption in that mode with the annual usage factor which is defined to be the number of hours per year that a PC is in a particular mode.

This methodology can be applied to any type of a device from the ICT space. While we tried to follow this methodology as far as possible in our analysis, scarcity of reliable data forced us to adapt this methodology further in a few cases, notably in the energy estimation of mobile phones as we will see in the sequel.

A. Converting Energy Consumption Into A Carbon Footprint :

$$CCN = \frac{\text{Carbon Emissions}}{\text{Electricity Consumption}} = \frac{lbs(or)Kgs}{KWhr}$$

	200	2015	2020
Data Centers	**205.28**	**399.78**	**660.86**
PCs	**214.39**	**386.79**	**923.91**
Mobiles	**2.61**	**6.51**	**11.77**
Gaming Consoles	**19.00**	**45.28**	**71.94**
Total	**441.30**	**838.36**	**1668.49**

The above table shows the summary of results for ICT Sector Energy Consumption in Billion of KWhrs

B. Resource Allocation:

Algorithms can be used to route data to data centers where electricity is less expensive. The efficiency of the 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 study by Alex Wissner- Gross, estimated that the average Google search released 7 grams of CO2. The whole idea of replacing physical movement with electronic communications like videoconferencing reduces environmental impacts. Power management software help the computers to sleep or hibernate when not in use. Reversible computing promises to reduce power consumption by a factor of several thousand.

VI. CONCLUSION

The plan towards green IT should include new electronic products and all possible options towards energy savings. 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. The waste heat also causes reliability problems, CPU's crash much more often at higher temperatures. Companies are competing in an increasingly 'green' market and must avoid the real and growing financial penalties that are increasingly being levied against carbon production. With the increasingly drive towards centralized mega data centers alongside the huge growth in power hungry blade technologies in some companies, and with a shift to an equally power-hungry distributed architectures in others, the IT function of business is driving exponential increase in demand of energy along with it, is having to bear the associated core increases. Businesses seeking a cost-effective way to responsibly recycle large amounts of computer equipment face a more complicated process. There exist companies that specialize in corporate computer disposal services both offer disposal and recycling services in compliance with local laws and regulations. Such companies frequently also offer secure data elimination services. The features of a green computer of tomorrow would be like: efficiency, manufacturing & materials, recyclables, service model, self-powering and other trends. Green computers will be one of the major contributions which will break down the 'digital divide'.

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