GREEN COMPUTING INITIATIVES FOR ENVIRONMENTAL ISSUES

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Abstract

At present Green Computing is under the consideration of businesses organisations and IT industries. With the advancement in variety of applications and user demands the infrastructure and resources are increasing exponentially. 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 paper presents several green initiatives under way in the IT industry and in brief covers the main research challenges which are still open in the race to meet green computing requirements.

1.   An Introduction :

Green Computing is a study of practice on developing or designing applications or system which can bring zero impact to the environment. This study focus on manufacturing and disposing computer resources like monitors, servers, CPU storage devices , networking and communication system efficiently without give impact to the environment. Green computing can helps on preventing global warming that cause of improper function in the natural atmosphere.

Green computing or **green IT**, refers to environmentally sustainable computing or IT. 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. Green IT also strives to achieve economic viability and improved system performance and use, while abiding by our social and ethical responsibilities. Thus, green IT includes the dimensions of environmental sustainability, the economics of energy efficiency, and the total cost of ownership, which includes the cost of disposal and recycling. It is the study and practice of using computing resources efficiently."

 With increasing recognition that man-made greenhouse gas emissions are a major contributing factor to global warming, enterprises, governments, and society at large now have an important new agenda: tackling environmental issues and adopting environmentally sound practices. Greening our IT products, applications, services, and practices is both an economic and an environmental imperative, as well as our social responsibility. Therefore, a growing number of IT vendors and users are moving toward green IT and thereby assisting in building a green society and economy.

2.   Why Green Computing :

In 2006, Greenpeace released a study for which researchers performed X-ray examinations of hazardous materials inside five leading brands of laptops.The findings revealed that many of the components found in popular computers are not only harmful to the environment, but also potentially harmful to humans [source: Greenpeace Research Laboratories]. For example, several of these laptops were found to contain a chemical known to cause cancer, nerve damage and immune reactions in humans.

This technology is beneficial as it:-
a.   Reduce energy consumption of computing resources during peak operation
b.   Save energy during idle operation
c.   Use eco-friendly sources of energy
d.   Reduce harmful effects of computing resources
e.   Reduce computing wastes

Global warming and the problem of minimising environmental impact from fossil-fuel emissions have raised to the top of global public policy agenda.

As a result, businesses and consumers alike have started to embrace environmentally sustainable products that offer low-carbon solutions that can not only reduce their global greenhouse gas (GHG) emissions, but can do so by more efficient energy consumption and lower costs. Smart deployment of more efficient computing resources, starting with green PCs, has become a key focus for many businesses and consumers looking to reduce their own energy consumption and carbon footprint. This is fuelled by an increase in public awareness of the effects of climate change, recognition by businesses and consumers that reducing energy usage can save costs and by government regulation covering everything from energy efficiency to power management and reduction of hazardous materials to e-waste disposal.

3.   Green Initiatives In Information Technology

It started way back in 1992, when the U.S. Environmental Protection Agency (EPA) launched Energy Star, a controlled labeling program that is planned to promote and recognize energy-efficiency in monitors, climate control equipment, and other technologies. This resulted in the widespread adoption of sleep mode among consumer electronics. Concurrently, the Swedish organization TCO Development launched the TCO Certification program to promote low magnetic and electrical emissions from CRT-based computer displays; this program was later expanded to include criteria on energy usage, ergonomics, and the use of hazardous materials in construction. With time IT industry has taken many initiatives towards green ICT (Information and Communication Technologies). The remarkable green initiatives in IT are:

1) Improved Data Center Cooling Methods: This is achieved by improving the data center cooling configuration, eliminating considerable amount of energy leaks. IT can result in efficient data centers by following leading practices in data centre layout and rack and server arrangements. Effective approach 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 .

2) Efficient Servers usage by Virtualization: Generally, IT companies have been using many server farms or data centers, dedicated to a specific task. These data servers must be efficiently used. One of the mechanisms is load balancing which chooses the optimum resource among many. Also by using virtual software to perform these tasks, a single server may be used to power these virtual servers, dramatically reducing energy consumption.

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) Using Thin Clients: With thin clients, each employee has a virtual desktop that includes a mouse, keyboard and screen while the remaining unit is shared by all at a central location.

5) Strengthen Printer's Output Management: Centrally located printer may be used to handle all printing tasks virtually eliminating numerous machines being left on all day sucking up energy and driving up costs.

6) Explore Alternative Sources of Energy: The efficient resource utilization leads towards efficient methods to evolve **.** With time renewable and natural energy sources are being used to power data centers, such as nuclear or hydroelectric power, solar energy etc. This saves money and generates fewer CO2 emissions.

7) Energy saver initiatives: This includes using energy saving settings and encouraging employees to turn off equipment at the end of the work day and on weekends.

8) Proper Disposal and Recycling: This is so important because it potentially eliminates the threat of harmful toxins being released into the environment and allows for the reuse of equipment reducing the amount of waste. These initiatives exhibit the requirement of going green. Along with above mentioned IT initiatives every sector and area of IT is practicing green strategy and policies because sustainable development of ICT is the future need.

4.   Open Research Challenges

Energy is one of the most valuable and scarce resources available to the world, a significant portion of which is now being consumed to power up computers and computing infrastructure. Basically, high-performance parallel and distributed computing system, including data centers, supercomputers, clusters, real-time systems, and grids not only consume considerable amounts of power but also require air-conditioning to keep the systems cool. The exponential growth in computing is rapidly increasing the consumption of precious natural resources such as oil and coal, strengthening the alarming danger of energy shortage. These issues have been raised by the researchers from time to time and the possible measures are being taken. Still there are many areas yet to be explored. Here we present some notable areas of research in green computing:

1: New Optimization Techniques in Performance-Energy-Temperature aware Computing: The exponential growth in computing activity and the rising concern for energy conservation have made energy efficiency in computers a technological issue of prime importance. The tradeoff between Performance-Energy-Temperature has to be made for so that the maximum benefits can be obtained. Designing techniques that are optimal with respect to performance, energy, and temperature are utmost requirement as far as green computing research challenges are concerned.

2: Information Resource Tier Optimization:
The information resource tier represents important data base management systems in the global computation world. General paradigms include databases, directories, file-systems, and flat files. It also includes the integration of different database structures so that different databases can be analyzed irrespective of their storing mechanisms and data structure. Big data research topic is open in this field.

3: Reduce architectural complexity: The research area is open to reduce the number of tiers and component dependency to reduce maximum system use. Intel's core 2 duo is a mechanism which uses power to run only those components which are necessary at any computation.

4: New high-efficiency data center design Bigger data centers can be made much more energy efficient than smaller data centers. Standards are emerging for measuring this, such as the concept of Power Usage Effectiveness (PUE). PUE is defined as the ratio of total facility power divided by IT equipment power . Thus, it is a measure of how much of the power being consumed by the facility is actually being used to power the IT equipment itself rather than all the other things. Therefore it will quiet be a challenge to make the bigger data centres power efficient

5: Developing Green Maturity Model: Full equipment life cycle is the main area for green maturity model, with energy reduction as the best measure of ―greenness.‖ The need **of maturity models** for equipments, IT organizations, computing techniques is an issue which has been addressed by some researchers but is limited to specific areas. Green maturity model for virtualization depicts that each level describes the degree of green characteristics.

6: Wireless Sensor Network for Data Center Cooling: data center cooling is a major issue as far as power consumption is concerned. Data centers are backbone of any computing organization and must be reliable and available at every point of time. Measuring the data center effectiveness and maintaining the baseline is an issue. Wireless sensors could play a big role for managing data centers power management

7: Green Software's: Recently, green software movement has become a research subject for most of the software developers companies because of need for sustainable development . Most of the research has been done on the characterization, metrics and technical answer for green software, but few have addressed green software from the business perspective. Business organizations are moving towards green software's and still some considerable steps need to be taken.

5.   Future of Green Computing

As 21st century belongs to computers, gizmos and electronic items, energy issues will get a serious ring in the coming days, as the public debate on carbon emissions, global warming and climate change gets hotter. If we think computers are non polluting and consume very little energy we need to think again. It is estimated that out of $250 billion per year spent on powering computers worldwide only about 15% of that power is spent computing- the rest is wasted idling. Thus, energy saved on computer hardware and computing will equate tonnes of carbon emissions saved per year. Taking into consideration the popular use of information technology industry, it has to lead a revolution of sorts by turning green in a manner no industry has ever done before. Opportunities lie in green technology like never before in history and organizations are seeing it as a way to create new profit centres while trying to help the environmental cause. The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings. Faster processors historically use more power. 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 and the HVAC. The waste heat also causes reliability problems, as CPU's crash much more often at high temperatures. Many people have been working for years to lice this inefficiency out of computers. Similarly, power supplies are notoriously bad, generally as little as 7% efficient. And since everything in a computer runs off the power supply, nothing can be efficient without a good power supply. Recent inventions of power supply are helping fix this by running at 80% efficiency or better.

6.   Conclusion

Technology is not a passive observer, but it is an active contributor in achieving the goals of Green Computing. IT industry is putting efforts in all its sectors to achieve Green computing. Equipment recycling, reduction of paper usage,virtualization, cloud computing, power management, Green manufacturing are the key initiatives towards Green computing. Current challenges to achieve Green Computing are enormous and the impact is on computing performance.Efforts of Governments and Non-Government Organizations (NGOs) are also appreciate-able. Government regulations are pushing Vendors to act green; behave green; do green; go green; think green; use green and no doubt to reduce energy consumptions as well. All these efforts are still in limited areas and currently efforts are mainly to reduce energy consumption, e-Waste but the future of Green Computing will be depending on efficiency and Green products. Future work in Green Computing discipline will also rely on research work
in academics since this is an emerging discipline and there is much more need to be done.

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