Green Computing Challenges and Strategies

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Abstract: *Focus on green computing has been growing lately. Green computing refers to supporting business critical computing needs with least possible amount of power or sustainable computing. This represents a dramatic change in priority in IT industry. In the past, the sole focus was on IT equipment processing power and associated equipment spending while infrastructure that includes power, cooling and data center space was always assumed available, ready, a given and affordable. Today, the infrastructure is becoming a limiting factor that can determine how and if IT equipment can be deployed to meet business growth while processing power is becoming a given, even though not ignored. The driving force behind this change comes from the ever growing business computing needs, fast growing burden of energy cost, growing awareness of global warming issues, and increasing sense of national energy security. On the fronts of global warming issues and energy security, various regulations and laws will soon be in place that will force the use of IT equipment that meet certain energy efficiency requirements. Equally important is the concern for ever growing cost burden for supporting growing business critical computing needs that outpace the infrastructure growth. This paper will provide a review of how IT equipment power consumption across the industry is changing the IT industry priority. It will focus on how equipment power consumption impacts the overall power usage and total cost of ownership and how the power issues may impact what customers may or may not buy and deploy to meet their business needs. It will also briefly cover the general technological trends in the IT industry of what technologies are available in the race to meet green computing requirements.*

Keywords: *Green Computing, Challenges, Strategies, Sustainable Software*

I. INTRODUCTION

Green Computing is defined as the effective and efficient use of computers and related technology by humans in an ecofriendly manner which minimizes the impact of carbon emissions on our environment. Green computing 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. It was primarily addressed by enhanced research and development efforts to reduce power usage, heat transmission, cooling needs of hardware devices, in particular processor chips using extensive hardware controls. Companies in every industry, are paying much closer attention to their electricity bills. Even consumers are now becoming increasingly aware of green technologies and are starting to demand more environment friendly products in their home and workplaces. Therefore green computing is the utmost requirement to protect environment and save energy along with operational expenses in today's increasingly competitive world. Computers become the requirement of present generation. It facilitate lots of things like data storage, fast communication weather forecasting, etcetera at one side, but it is becoming the big source of pollution on the other side. So existing Technologies want to manufacture the computers and its components in minimal resources with lesser use of those products which causes pollution. This approach is called Green IT or green computing. So green IT can be described as "It is the study or approach for the designing, manufacturing, using, and arrangement of computers, servers, and related components-such as HDMI cables, monitors, printers, storage devices, and networking & communications systems effectively& efficiently." Every organizations and companies want to adopt green IT but due to some reasons it faces difficulties.

II. LITERATURE SURVEY

Shivam Singh[1] proposed to improve energy efficiency by reducing the carbon footprint in IT industry. Nitin S. More and Rajesh B. Ingle [3] suggested the use of Virtual Machines with better efficiency to reduce CO_2 emission to the nature. Eva Kern[7] conducted a survey on sustainable software and found out that the awareness of green computing is very less in the common people. David Wang[6] discussed about the energy consumption of an equipment in production and in operation, however he didn't study about the end-of-life product recycling. Shwetha Vikram [5] felt that by going "green" in technology, we help promote an eco-friendly and cleaner environment, along with our own benefits by reducing costs, conserving energy, cutting down on waste and greenhouse gases. Sharmistha Dutta[2] has explained green computing by taking economic issues into consideration.

III. CURRENT STRATEGIES IN GREEN COMPUTING

Current trends of Green Computing are towards efficient utilization of resources. Energy is considered as the main resource and the carbon footprints are considered the major threats to environment. Therefore, the emphasis is to reduce the energy utilization & carbon footprints and increase the performance of Computing. There are several areas where

researchers are putting lots of efforts to achieve desired results:

EFFICIENT ENERGY CONSUMPTION

Organizations are realizing that the source and amount of their energy consumption significantly contributes to Greenhouse Gas (GhG) emissions. In response to this finding, organizations are currently using the following equation: Reduced energy consumption = Reduced greenhouse gas emissions = Reduced operational costs for the data center. Reduced operational costs for the data center It means adopting fewer and more energy efficient systems while refactoring application environments to make optimal use of physical resources is the best architectural model. According to Environmental Protection Agency in around 30% to 40% of personal computers are kept 'ON' after office hours and during the weekend and even around 90% of those computers are idle.

E-WASTE RECYCLING

Based on the Gartner estimations over 133,000 PCs are discarded by U.S. homes and businesses every day and less than 10 percent of all electronics are currently recycled. Majority of countries around the world require electronic companies to finance and manage recycling programs for their products especially underdeveloped Countries. Green Computing must take the product life cycle into consideration; from production to operation to recycling. E-Waste is a manageable piece of the waste stream and recycling e-Waste is easy to adopt. Recycling computing equipment such as lead and mercury enables to replace equipment that otherwise would have been manufactured. The reuse of such equipment allows saving energy and reducing impact on environment, which can be due to electronic wastes.

DATA CENTER OPTIMIZATION

Currently much of the emphasis of Green Computing area is on Data Centers, as the Data Centers are known for their energy hunger and wasteful energy consumptions. United State Department of Energy (DoE) reported in its study in 2006 that United States data centers consumed 1.5% of all electricity and their demand is increasing by 12% per year and cost $7.4 billion per year by 2011. According to DoE's current report in July 2011 Data Centers are consuming 3% of all US electricity and this consumption will double by 2015. With the purpose of reducing energy consumption in Data Centers it is worthwhile to concentrate on following: Information Systems – efficient and right set information systems for business needs are a key in building Green Data Centers. As per green computing best practices efficient servers, storage devices, networking equipment and power supply selection play a key role in design of information systems.
Cooling Systems – it is suggested by the researchers that at the initial stage of design process for data center cooling systems, it is significant to consider both current and future requirements and design the cooling system in such a way so

it is expandable as needs for cooling dictates. Standardized environment for equipment is must for Data Center Air Management and Cooling System. Consider initial and future loads, when designing and selecting data center electrical system equipment.

VIRTUALIZATION

One of the main trends of Green Computing is virtualization of computer resources. Abstraction of computer resources, such as the running two or more logical computer systems on one set of physical hardware is called virtualization. Virtualization is a trend of Green computing it offers virtualization software as well as management software for virtualized environments. One of the best ways to go towards green and save enough space, enough resources, and the environment is by streamlining efficiency with virtualization. This form of Green Computing will lead to Server consolidation and enhance computer security. Virtualization runs fewer systems at higher levels of utilization. Virtualization allows full utilization of computer resources and benefits in: Reduction of total amount of hardware; Power off Idle Virtual Server to save resources and energy; and Reduction in total space, air and rent requirements ultimately reduces the cost.

IT PRODUCTS AND ECO LABELLING

Another approach to promote Green Computing and save environment is to introduce policies all around the World, so that, companies design products to receive the eco-label. There are several organizations in the world which support eco-label IT products. These organizations provide certificates to IT products based on factors including design for recycling, recycling system, noise energy consumption etc.

IV. CHALLENGES

According to researchers in the past the focus was on computing efficiency and cost associated to IT equipment and infrastructure services were considered low cost and available. Now infrastructure is becoming the bottleneck in IT environments and the reason for this shift is due to growing computing needs, energy cost and global warming. This shift is a great challenge for IT industry. Therefore now researchers are focusing on the cooling system, power and data center space. At one extreme it is the processing power that is important to business and on the other extreme it is the drive, challenge of environment friendly system, and infrastructure limitations. Green Computing challenges are not only for IT equipment users but also for the IT equipment Vendors. Several major vendors have made considerable progress in this area, for example, Hewlett-Packard recently unveiled what it calls —the greenest computer ever" - the HP rp5700 desktop PC. The HP rp5700 exceeds U.S. Energy Star 4.0 standards, and has an expected life of at least five years, and 90% of its materials are recyclable. Dell is speeding up its programs to reduce hazardous substances in its computers, and its new Dell OptiPlex desktops are 50% more energy-efficient than

similar systems. Manufactured in 2005, credit goes to more energy efficient processors, new power management features, and other related factors. IBM is working on technology to develop cheaper and more efficient solar cells plus many other solutions from IBM to support sustainable IT. According to researchers of Green Computing following are few prominent challenges that Green computing is facing today:

1. Equipment power density / Power and cooling capacities; 2. Increase in energy requirements for Data Centers and growing energy cost; 3. Control on increasing requirements of heat removing equipment, which increases because of increase in total power consumption by IT equipment; 4. Equipment Life cycle management – Cradle to Grave; and 5. Disposal of Electronic Wastes.

V. CONCLUSION

While the use of computers is increasing day by day, and so is the CO_2 emissions. So awareness should also be increased regarding green computing. Through more environmentally aware usage (such as more effective power management and shut-down during periods of inactivity), and by adopting current lower power technologies, computers can already be made significantly more energy efficient. The computing industry is definitely improving the energy efficiency. It is more prepared and far more competent than almost any other industry when it comes to facing and responding to rapid change. Hopefully it will take a matter of years to reach a state of affairs where most computers are using far less power than they needlessly waste today.

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