A GREENER APPROACH TO COMPUTING AND SAVE ENERGY

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ABSTRACT

Green computing, also called green technology, is the environmentally sustainable to use of computers and related resources like - monitors, printer, storage devices, networking and communication systems - effectively with minimal or no impact on the environment. Green computing whose goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste. Computers today not only used in offices but also at homes. Therefore , this can be called as Green Computing. We use Green Computing because it- reduced energy usage from green computing techniques translates into lower carbon dioxide emissions, stemming from a reduction in the fossil fuel used in power plants and transportation, Conserving resources means less energy is required to produce, use, and dispose of products,Saving energy and resources saves money .Green computing even includes changing government policy to encourage recycling and lowering energy use by individuals and businesses. It also includes why computing, approaches green, reduce power consumption, recent implementation and future trends

Keywords: Green Computing, Electronic-waste, Energy Star, EPEAT, Save Mother Earth.

I. INTRODUCTION

Figure: 1 Green computing

Green Computing is also defined as the study of designing, manufacturing/engineering, using and disposing of computing devices in a way that reduces their environmental impact. IT department is usually always the one department that uses the most amount of power which in turn is an excessive amount of "Green computing" represents environmentally responsible way to reduce power and environmental e-waste [3]. Virtualization, Green Data Centre, Cloud computing, grid computing, Power optimization are the technologies of green computing. Main goals of green computing are to reduce the use of toxic and hazards materials and improve the energy efficiency, recycling of factory waste. Such practice includes the efficient implementation of server and peripherals as well as reduces the power consumption. It shows how to use resources efficiently and how to reduce the waste Green computing is the requirement to save the energy with the expenses [1] .Currently the implementation on green computing practice is going on, but firstly we have to know what kind of energy should be gained and how it is achieved. So analysis of the gap what are the resources we have and what we are going to do to achieve the benefits of green computing, overhead for a business as well as a source for toxic waste. Making IT "Green" can not only save money but help save our world by making it a better place through reducing and/or eliminating wasteful practices and using nontoxic materials[6].

II. HISTORY OF GREEN COMPUTING

One of the earliest initiatives toward green computing in the United States was the voluntary labeling program known as Energy Star. It was conceived by the Environmental Protection Agency (EPA) in 1992 to promote energy efficiency in hardware of all kinds [1.] The Energy Star label became a common sight, especially in notebook computers and displays. Virtualization practices, e-waste, etc. Similar programs have been adopted in Europe and Asia.

Energy Star served as a kind of voluntary label awarded to computing products that succeeded in minimizing use of energy while maximizing efficiency.[4] Energy Star applied to products like computer monitors, television sets and temperature control devices like refrigerators, air conditioners, and similar items. One of the first results of green computing was the Sleep mode function of computer monitors which places a consumer's electronic equipment on standby mode. When a pre-set period of time passes when Organizational policies should include communication and implementation.

III. WHY GREEN COMPUTING

Today almost all streams weather its IT, medicine, transportation, agriculture uses machines which indirectly requires large amount of power and money for its effective functioning. We have great machines and equipment's to accomplish our tasks, great gadgets with royal looks and features make our lives more impressive and smooth. Green computing whose goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste[6].

We use Green Computing for following benefits[11]-

1. Using ENERGY STAR qualified products help in energy conservation.

2. The Climate Savers Computing Initiative (CSCI) catalog can be used for choosing green products.
3. Organic light-emitting diodes should be used instead of the regular monitors.
4. Surge protectors offer the benefit of green computing by cutting off the power supply to peripheral devices When the computer is turned off.
5. Donating your old computers and other peripherals can reduce the rate of e-waste creation.
6. Moreover, those who cannot afford to buy a computer can benefit from such donations. Through proper disposal of computer and its accessories, it is possible to reduce environmental pollution.
7. It was expected that computers would help reduce paper wastage. The easy availability of photocopiers and printers is also one of the culprits behind unchecked paper wastage. Think twice before using printers.
8. Use the device only if it is necessary.
9. The manufacturing of disks and boxes needed for video games takes up a lot of resources. Video game manufacturers can offer their games online for download, leading to reduction in e-waste.
10. Use of 'Local Cooling' software can help in monitoring and thereby, bringing down the energy consumed by your computer. This 'Windows' program makes adjustments to the power options of your computer and helps minimize energy consumption**.**

IV. APPROACHES TO GREEN COMPUTING

4. 1. Green Data Center

Data centers or computer center has a computer system and its associated system such as telecommunication system data storage system. It needs backup power supply, some cooling system and security system. A green data center is a data center which has a efficient management of the system and associated system less power consumed environment [10].

4.1.1 Practical requirement of data centers are as follows:

- Provide a physical secure location for server.
- Should provide all-time network connectivity in data center.
- Should provide necessary power to operate all equipment.

Characteristics:

- Design must be simple.
- Design must be scalable.

The design should be scalable because once it finalize must work for any size of computer center.

- Design must be modular.
- Design must be flexible.

4.2. Virtualization

Virtualization, a term that used to the various techniques, methods or approaches to create a virtual environment, such as a virtual hardware platform, virtual operating system (OS), storage device, or network resources[10].

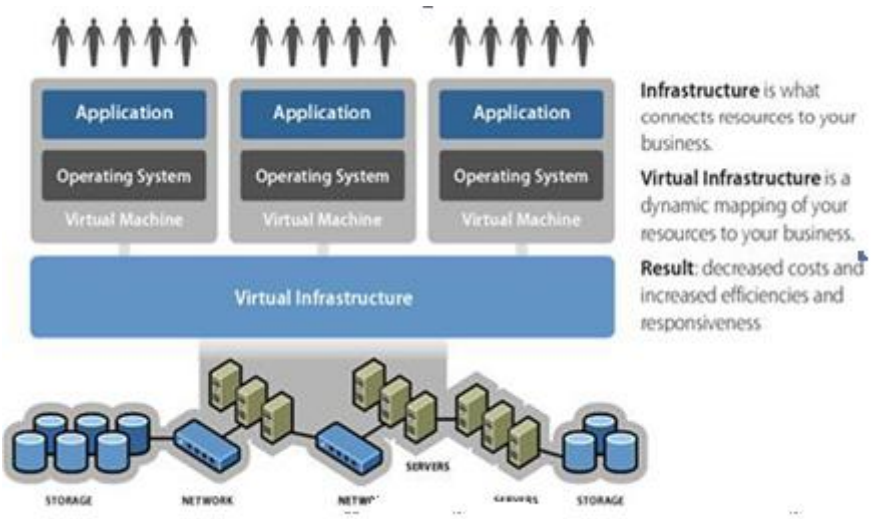

Figure 2: Virtualization

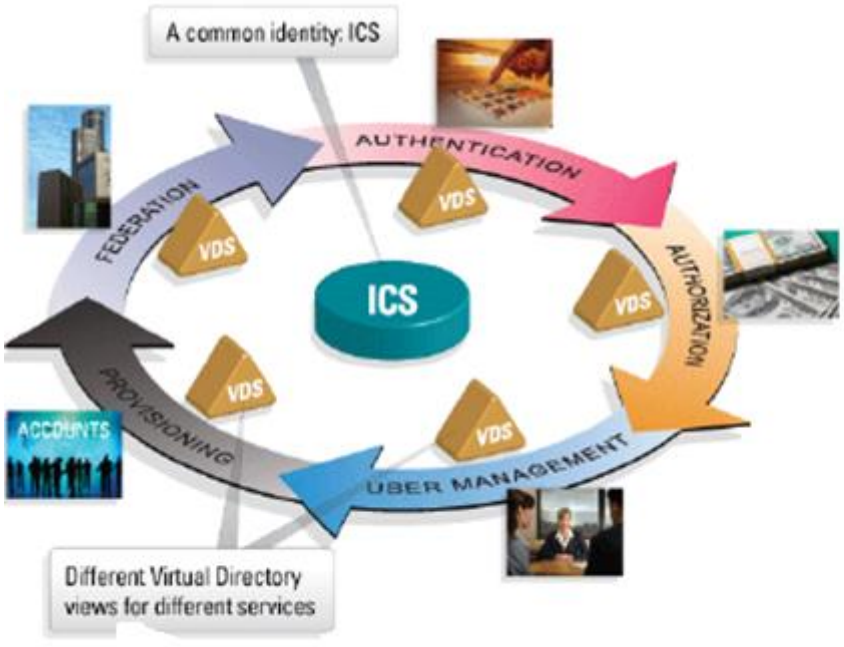

Figure 3: Virtualization Benefits

4.2.1. Challenges

Complexities of licensing are the issue with virtualization. For example a Linux based server offers a virtualized windows server must satisfy licensing requirements. Because of this licensing issue flexibility of virtualization and benefits of on demand virtualization is hampered. Some venders of proprietary software have attempted to update licensing scheme to address the virtualization but flexibility and cost issues are opposing requirements. Virtualized desktop results in dependence on centralized servers (for computing and SAN storage) and the network (and higher-bandwidth requirements). Dependency on centralized server and network leaves the end users vulnerable to server. The user able to operating locally through an outage, but when user logs off or reboots the machine it become dead This is in contrast with thick clients where the user operate locally continue until the connectivity can be restored.

4.3. Cloud Computing

Cloud computing name comes from the cloud shaped symbol in which the complex infrastructure is hidden as it contain in its system diagram. Cloud computing delivered the computing resources as a service over the internet. Cloud computing provide user's data, software remote data server[5]. As well as Cloud computing allows companies to avoid infrastructure cost, and focus on projects that differentiate remotely End user can use the cloud services or cloud application through a web browser or a mobile app while the software and user's data is stored on their business. Cloud computing allows enterprises to get their application up running faster with improved man power and less maintenance and enable IT to more rapidly adjust resources to meet the unpredictable business demand.

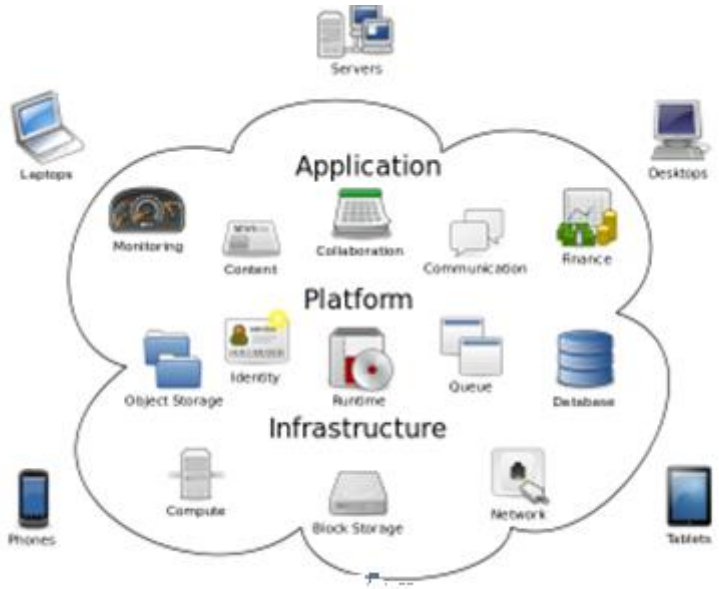

Figure. 4. Cloud Computing

4.3.1. Infrastructure as a Service (Iaas)

In the cloud service model providers offers Physical or more often virtual machine. A hypervisor such as Xen or KVM runs the virtual machine. Hypervisors pools within a cloud support system can support large number of virtual machine and can maintain the sale ability of services according to customer requirements. IaaS clouds offer other additional resources such as virtual machine disk, image library, IP address, and firewalls etc, Iaas providers supply these resources on demand from their data centres.

4.3.2. Platform as a Service (Paas)

In the Paas model, Cloud provider offers computing platform including operating system, execution environment, and database and web server. Developer can develop and run their software on a cloud platform without any complexity and cost of buying and managing the hardware and software layer.

4.3.3. Software as a Service

In the SaaS model providers install application software in the cloud and users can access the software from clients. Cloud users do not manage the infrastructure and platform. SaaS eliminates the need to install the software and run the application on the user's own computer which simplifies maintenance and support. Cloud application are different from others in their scalability, scalability can be achieved by cloning onto multiple VM's at run time to meet work demands.

4.4. Telecommuting

Telecommuting, e-commuting, e-work, telework, working at home (WAH), or working from home (WFH) is a work arrangement in which employees enjoy flexibility in working location and hours. A frequently repeated motto is that "work is something you do, not something you travel to". Long distance telework is facilitated by such tools as virtual private networks, videoconferencing, and Voice over IP. It can be efficient and useful for companies as it allows staff and workers to communicate over a large distance, saving significant amounts of travel time and cost[8]. As broadband Internet connections become more commonplace, more and more workers have enough bandwidth at home to use these tools to link their home office to their corporate intranet and internal phone networks.

Voice over Internet Protocol (VoIP) is a general term for a family of transmission technologies for delivery of voice communications over the Internet or other packet-switched networks. The reduction in telephone wiring will obviously lead to decreasing costs because of Voice-Over-Internet protocol. Voice over IP (VoIP) reduces the telephony wiring infrastructure by sharing the existing Ethernet copper, thus reduce the use of metallic waste. VoIP and phone extension mobility also made Hot-desking and more practical.

Figure: 5 Voice over Internet Protocol (VoIP)

4.5. Recycling

Many materials used in the construction of computer hardware can be recovered in the recycling process for use in future production. Reuse of tin, silicon, iron, aluminium and a variety of plastics – all present in bulk in computers – can reduce the costs of constructing new systems. Electronic devices, including audio-visual components (televisions, VCRs, stereo equipment), mobile phones and other hand-held devices, and computer components, contain valuable elements and substances suitable for reclamation, including lead, copper, and gold. They also contain a plethora of toxic substances, such as dioxins, PCBs, cadmium, chromium, radioactive, and mercury [14].

V. REDUCE THE POWER CONSUMPTION

5.1. Power Aware Hybrid Deployment

In this they investigate the resource allocation between virtual machines where 1/0 and CPU-Intensive applications reside, to realize power-aware applications hybrid deployment[7]. To demonstrate the problem of I/0 and CPU resource in virtualization environment, They use Xen as the Virtual Machine Monitor for experiments. Under different resource allocation configurations, they evaluate power efficiency up to 2 % - 12 %, compared to the default deployment.

They also conclude the more CPU resource that the CPU-Intensive applications in the hybrid deployment applications need to satisfy QoS. They get that server virtualization techniques provide a smooth mechanism for power-performance tradeoffs in modem data centers running heterogeneous applications. Virtual Machine Monitors (VMMs) are gaining popularity in enterprise data centers. But traditionally, VMM schedulers have focused on fairly sharing the processor resources among domains while leaving the scheduling of I/O resources as a secondary concern [11].

This can result in unpredictable I/O behaviour, and poor and/or unpredictable application performance and power efficiency. They focus on the unpredictable 1/0 behaviour under current VMM schedulers. In order to implement motivation and achieve CPU Intensive and I/O-Intensive applications hybrid deployment within

virtualization environments, we face some challenges to explore the unpredictable I/O behaviour. Before expressing these challenges, they make some additional introductions. Their work will focus on Xen VMM, which is an open source virtual machine monitor based on the Linux kernel.

Organization of Xen effectively consists of two elements: the hypervisor and the driver domain. One of the major functions of the driver domain is to provide access to the actual hardware I/0 devices. The hypervisor grants the driver domain direct access to the devices and does not allow the guest domain to access them directly [9]. Therefore, all I/0 traffic must pass through the driver domain. So the performance of server residing in guest domain will depend on CPU allocated to the driver domain.

They make the power model, which shows the relationship between power and server utilization within the test bed .In other sub section resource utilization under various workload is recorded and at the last they introduce power efficiency evaluation proposal which they used and the improvement of power efficiency under different configuration is shown. Firstly they calculated power consumption and calculate power efficiency.

5.1.1. Power and Utilization

Power consumption is expressed as a percentage of peak power across the data center. Power consumption, for a fixed operating frequency, the power consumption of the server is approximately linear functions of the server utilization.

After completion of two other sections they conclude from the analysis, they obtain that CPU-Intensive and 1/0-Intensive applications hybrid deployment can improve power efficiency.

5.2. Power and Energy Management For Server System

Power and energy consumption are key concerns for data centres. These centres house hundreds or thousands of server and supporting cooling infrastructures. Previous research on power and energy management for servers can ease installation, reduce costs, and save the environment. Given these benefits, researches have made important strides in conserving energy in servers [4].

VI. RECENT IMPLEMENTATIONS OF GREE COMPUTING

6.1. Blackle

Is a search-engine site powered by Google Search. Blackle came into being based on the concept that when a computer screen is white home , your computer consumes 74W. When the screen is black it consumes only 59W.Based on this theory if everyone switched from Google to Blackle, mother earth would save750MW each year[11]. This was a really good implementation of Green Computing. The principle behind Blackle is based on the fact that the display of different colors consumes different amounts of energy on computer monitors.

6.2. Fit-PC

A tiny PC that draws only 5w: Fit-PC is the size of a paperback and absolutely silent, yet fit enough to run Windows XP or Linux. fit-PC is designed to fit where a standard PC is too bulky, noisy and power hungry. If

you ever wished for a PC to be compact, quiet and green then fit- PC is the perfect fit for you. Fit-PC draws only5 Watts, consuming in a day less power than a traditional PC consumes in 1 hour. You can leave fit-PC to work 24/7 without making a dent in your electric bill[14].

6.3. Zonbu Computer

The Zonbu is a new, very energy efficient PC. The Zonbu consumes just one third of the power of a typical light bulb. The device runs the Linux operating system using a1.2 gigahertz processor and 512 meg of RAM. It also contains no moving parts, and does even contain a fan. You can get one for as little as US$99, but it does require you to sign up for a two-year subscription[13].

6.4. Sunray Thin Client

Sun Microsystems is reporting increased customer interest in its Sun Ray, a thin desktop client, as electricity prices climb, according to Subodh Bapat, vice president and chief engineer in the Eco Responsibility office at Sun. Thin clients like the Sun Ray consume far less electricity than conventional desktops, he said.[.14] A Sun Ray on a desktop consumes 4 to 8 watts of power, because most of the heavy computation is performed by a server. Sun says Sunrays are particularly well suited for cost-sensitive environments such as call centers, education, healthcare, service providers, and finance. PCs have more powerful processors as well as hard drives, something thin clients don't have. Thus, traditional PCs invariably consume a substantially larger amount of power. In the United States, desktops need to consume 50 watts or less in idle mode to qualify for new stringent Energy Star certification [6].

6.5. The Asus Eee PC and Other Ultra Portables

The "ultra-portable" class of personal computers is characterized by a small size, fairly low power CPU, compact screen, low cost and innovations such as using flash memory for storage rather than hard drives with spinning platters. These factors combine to enable them to run more efficiently and use less power than a standard form factor laptop[11]. The Asus Eee PC is one example of an ultraportable. It is the size of a paperback, weighs less than a kilogram, has built-in Wi-Fi and uses flash memory instead of a hard drive. It runs Linux too.

VII. FUTURE OF GREEN COMPUTING

The future of Green Computing is going to be based on efficiency, rather than reduction in consumption. The primarily focus of Green IT is in the organization’s self interest in energy cost reduction, at Data Centers and at desktops, and the result of which is the corresponding reduction in carbon generation[11]. The secondary focus of Green IT needs to focus beyond energy use in the Data Center and the focus should be on innovation and improving alignment with overall corporate social responsibility efforts. This secondary focus will demand the development of Green Computing strategies [14]. The idea of sustainability addresses the subject of business value creation while ensuring that long term environmental resources are not impacted.

There are few efforts, which all enterprises are supposed to take care of

7.1. Certifications

There are several organizations providing certificates to green technology. Vendors are based on their product quality, material, life of the product and recycling capabilities. In future such certifications together with recommendations and government regulations will put more pressure on vendors to use green technology and reduce impact on environment.

7.2. Cloud Computing

In principle, cloud computing is energy-efficient technology for ICT provided that it's potential for significant energy savings that have so far focused on only hardware aspects, can be fully explored with respect to system operation and networking aspects also. Cloud Computing results in better resource utilization, which is good for the sustainability movement for green technology.

7.3. Power Management Tools

Power management is proving to be one of the most valuable and clear-cut techniques in near future to decrease energy consumption. IT departments with focus on saving energy can decrease use with a centralized power management tool. Compiling data from Energy Star case studies for 7deployments of 11,000 - 499,000 machines, it was found that sleep scheduling was able to save between $10.75 and $95 per computer per year.

7.4. Leveraging Unused Computer Resource

Leveraging the unused computing power of modern machines to create an environmentally proficient substitute to traditional desktop computing is cost effective option. This makes it possible to reduce O2 emissions by up to 15 tons per year per system and reduce electronic waste by up to 80%.

7.5. Data Compression

In enterprise, huge amount of data that is stored is someway or other duplicated information. Information System backups are true example of such duplicated data. Intelligent compression techniques can be used to compress the data and eliminate duplicates help in cutting the data storage requirements.

7.6. Applications

Green Computing is a diverse field and due to its nature and priority from all fields of life Green Computing has applications in every sector of computing as the goal is to save the environment and ultimately the life.

The current main applications of Green Computing are covering following computing sectors

- Equipment design.
- Equipment recycling;

- Data Center optimization and consolidation;
- Virtualization;
- Paper free environment;
- Application Architecture; and
- Power Management

VIII. CONCLUSION

This paper is survey or a brief study about a green computing .The study will also tells the approaches of green computing. What and how much work done in green computing and how the power consumption is reduced through different approaches and key challenges facing to accomplish the goal. The concept of green computing is popularized in the past few years. Apart from ecological issues, this also deals in economic needs. This paper aimed to provide a survey on the current state-of-the-art in green computing. In addition, details of some real solutions have been showed as well. In the future we can save more energy through several approaches which are shown in the paper like virtualization, data centre and many other approaches. i.e. cooling of server, we can analysis the energy conservation and optimize it.

ACKNOWLEDGEMENT

I thank Almighty God for giving me the courage and the determination, as well as guidance despite all difficulties. I also extend my heartfelt gratitude to my husband and children. I am honoured to have you as my parents, Thank you for giving me a chance to prove and improve myself through my entire walk to life.

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