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Green Enterprise Computing- Approaches Towards a Greener IT

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Abstract— Green Enterprise Computing refers to how business or corporate sectors can deal with the prospect of Green Computing to manage power consumption and boost energy efficiency. Green Computing or Green IT is the study and practice of using computing resources in an eco-friendly manner to tone down the environmental impacts of computing.[1] In recent years, this practice has drawn serious attention from educational institutions, environmental organizations and the corporate and business sector, among others. In the 21st century, the business landscape has also expanded and the use of computers and other power devices has increased tremendously. All these, in turn, bring up the issue of reducing unscrupulous use of resource and power. Taking a careful approach to make our IT industry greener falls in our list of responsibilities towards creating a healthier, cleaner and safer environment, and spreading awareness and ensuring people to take necessary individual as well as collective actions to achieve the goals of Green Enterprise Computing is one of our major steps. [2] In the present paper we discuss how Green Computing can be incorporated into different industries, corporate and business sectors and in various IT companies.

Keywords— Green Computing, Green Enterprise Computing, Energy Efficiency, Resource Efficiency, IT, Laptop, Desktop, Cloud Computing

I. INTRODUCTION

Green Computing comprises of utilizing computing resources in an efficient, eco-friendly and sustainable manner.[3] Green computing or green IT, basically concerns to environmentally sustainable computing or IT.[4] Green Enterprise Computing is a systematic improvement over the existing practices of green computing in various corporate and business sectors, and the way to move forward with the existing infrastructure. Green IT refers to the solutions of the IT industry that save energy.

As more IT professionals are put under pressure to ensure the IT investments are made in all the right places, a common goal has been to review and possibly reallocate resources elsewhere. The depletion of resources nowadays and the huge cost of energy lead to many efforts from both research and industry for energy efficient computing, especially in the enterprise. Enterprise computing is diverse, both in workloads as well as equipment. Correspondingly, these computing systems must use techniques to save and manage energy consumption.

Desktops dominate a significant portion of the enterprise today. According to research it is seen that nearly 66% industries still focus on using desktop. Modern operating systems can put a machine to sleep mode when idle. In practice, however, users rarely activate these features and IT departments often disable these features to make patching, backup, and maintenance easier.

Another of the vital practices is to eliminate or reduce e-waste by reducing and recycling old machineries and systems or even donate still-working computers to non-profit agencies. [2] Some more relevant practices in this regard are listed below:

- Purchase of products that are environmentally green and consume less energy.
- Minimizing the consumption of paper and thus aiming for an eco-friendly environment.
- Reducing enterprise workloads by managing a distributed architecture instead of centralized power utilization.[5]
- Following energy efficient computing techniques in the enterprise, such as:
  - Grouping all computer activities for the day as far as practicable so that they can be performed at one go and the machines can be turned off for the rest of the day.
  - Turning on peripheral devices and computer equipments only when they are required.
  - Using backups, standbys and other alternatives to manage server workloads.[6]

II. METHODOLOGIES AND APPROACHES

II.1. Reducing use of paper

Much of our communication and documentation is still conducted via a paper trail. Not only does this leave piles of paper to manage, there is the economic cost of all the ink and paper and, more importantly, there is also an environmental cost involved with printing that we all bear as a society. The environmental impact of printing is considerable and wide ranging. The printing industry is one of the most polluting industries in the world for the following reasons:

- *The printing industry uses significant amounts of energy from heating and lighting to powering equipment and final delivery.*
- *Large quantities of water are used in most printing processes. In most of the cases, contaminated water is disposed without cleaning.*
- *Relatively high levels of waste are generated in the print process. From printing plates and ink tins to pallets and packaging there is plenty of waste produced by the printing industry.*
- *Many volatile organic compounds (VOCs) are said to stem from the printing industry. As the ink dries, the isopropyl alcohol used as a damping solution, evaporates at room temperature, releasing VOCs. These are colorless, odorless gases that are harmful to the surroundings; contribute to global warming and the production of ozone, as well as being hazardous to pressroom workers.*
- *To make paper, pulpwood trees are cut down in large numbers and are then transported to paper mills where pulpwood fibres are compressed and dried into sheets. This process is extremely energy consuming and the contaminated waste water produced pose a major environmental hazard. Further, the impact of deforestation on the environment is a greater cause for concern.*

The following policies can be adopted to reduce paper wastes in the enterprise:

- *Memos and newsletters that employees should see, but need not keep can be posted online.*
- *Document editing and formatting features of prevalent word processing software can be exploited instead of making drafts on paper.*
- *Information can be exchanged electronically via e-mails and formal online forums instead of fax or mailed letters when possible.*
- *An electronic filing system can be put in place for easy and efficient storage and retrieval of all electronic documents.[7]*

II.2. DESKTOPS VS LAPTOPS

Laptop computers may lack the sheer power of their desktop counterparts, but they are more viable from a green computing perspective.

The following points highlight some of the benefits of using laptops over desktops:

- *Energy efficiency*. Laptops consume on average 20-50 watts of electricity (which can be further trimmed in power saving modes) whereas desktops consume about 60-200 watts.[8] The conventional Cathode Ray Tube (CRT) monitors of desktops also consume more power than the Liquid Crystal Display (LCD) monitors of modern laptops. A laptop is always better to use than a desktop computer as it uses 1/3 of the energy and is portable thus taking up less room.[1] The fundamental issue with current desktops is that they consume substantial energy even in idle mode, but by their design, laptops consume much less active power.

- *Battery Power.* Laptops benefit from energy efficiency as a necessary consequence of their battery-powered design so much so that manufacturers often tout how long laptop computers can run on battery power as a selling point. The prospect of extending the battery life of laptops can be approached from two perspectives:
  - Adding a larger, higher-capacity battery to the laptop
  - Designing the laptop hardware to consume less energy.

- *Less Potential, Less Consumption.* Laptops have a lower potential for maximum power consumption because they feature smaller power supply units (PSUs). A performance desktop computer has the potential to draw 400Wh energy at full load with a larger PSU, whereas a performance laptop may be limited to 90Wh because of its smaller PSU.[1] Laptops often include substantially slower performing but more energy efficient processors and other components, compared to similarly-named desktop parts, so processes may take longer to complete. However, many firms such as Intel have already developed greener desktop computing in a big way with highly energy-efficient processors like Atom.

As a final remark, hardware manufacturers should avoid using substances like lead, mercury, cadmium, beryllium, brominated flame retardants (BFRs) and polyvinyl chloride (PVC) to make computer parts so that e-wastes can be safely recycled.

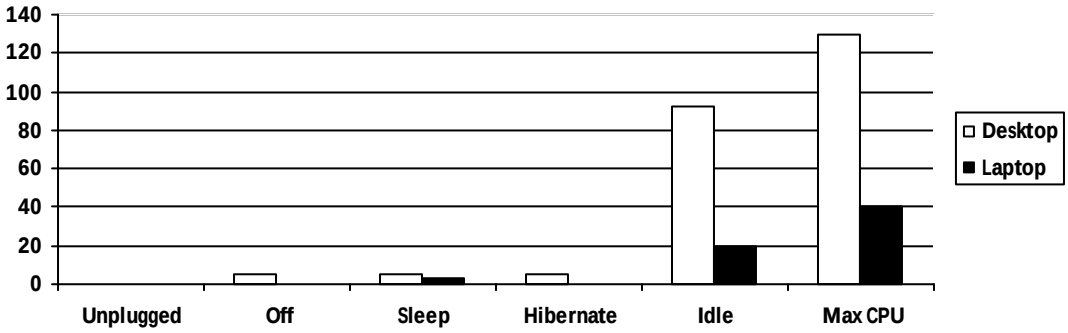

Figure 1: Desktop vs. laptop power consumption. [1]

Businesses are increasingly switching to or substituting on premises solutions with cloud-based models for resource and processing power requirement to tap benefits like faster scale up/scale-down of capacity, pay-per-use pricing, and access to various cloud-based applications. [9] Cloud computing solutions also enable enterprises to ―virtual cloud servers. It eliminates the need to install and maintain bulky, energy consuming physical servers by relocating them on the Internet.

In many small business and corporate environments, server utilization rates are around 5 or 10 percent, but with the cloud, utilization rates are typically 60-70 percent due to shared data centers that employ fewer machines to get an equivalent capacity. [10] The cloud-based alternative can be used in areas such as data storage, networking, software applications and operating systems. As a result, corporate or business sectors can save a lot of money, time and resources on maintenance and support.

The cloud infrastructure addresses two critical elements of a green IT approach: *resource efficiency* and *energy efficiency* (Fig-2). [9] Whether done in a private or a public cloud configuration, it will be greener for the following reasons:

- *Resource virtualization.* Virtualization is a foundational technology for deploying cloud-based infrastructure that allows a single physical server to run multiple operating system images concurrently. As an enabler of consolidation, server virtualization reduces the total physical server footprint, which has inherent green benefits.

From a resource-efficiency perspective, less equipment is needed to run workloads, which proactively reduces data center space and the eventual e-waste footprint. From an energy-efficiency perspective, with less physical equipment plugged in, a data center will consume less electricity.

It is worth noting that server virtualization is the most widely adopted green IT project implemented or planned, with 90 percent of all IT organizations worldwide adopting it by 2011. [9]

- *Automation software.* The presence of virtualization alone does not maximize energy and resource efficiencies. To rapidly provision, move, and scale workloads, cloud-based infrastructure relies on automation software. Combined with the right skills and operational and architectural standards, automation allows IT professionals to make the most of their cloud-based infrastructure investment by pushing the limits of traditional consolidation and utilization ratios. The higher these ratios are, the less physical infrastructure is needed, which in turn maximizes the energy and resource efficiencies from server virtualization.[9]

- *Pay-per-use self-service.* The pay-per-use nature of cloud based infrastructure encourages users to only consume what they need and not more. Combined with self-service, lifecycle management will improve, as users will ―turn off or reallocate resources and infrastructure after use. The pay per-use self-service capability of the cloud thus drives resource and energy efficiencies simultaneously.[9]

- *Multi-tenancy.* Multi-tenancy allows many different organizations (public cloud) or many different business units within the same organization (private cloud) to benefit from a common cloud-based infrastructure.

- By combining demand patterns across many organizations and business units, the peaks and troughs of computing requirements flatten out. Combined with automation, the ratio between peak and average loads become smaller, this in turn reduces the need for extra infrastructure. The result: massive efficiencies and economies of scale in energy use and infrastructure resources. [9] Thus migrating workloads to cloud resources, or developing new workloads in a cloud-native environment, can help an IT organization contribute to global energy-efficiency and sustainability goals. Cloud providers, on their part, can take advantage of efficient layouts such as rack-first that are hard for in-house centers to replicate to make the cloud servers greener.

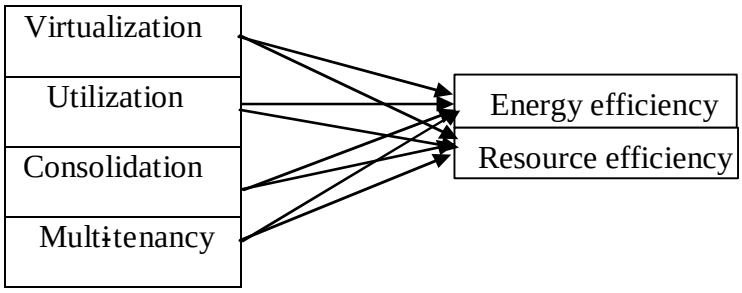

Figure 2: The Cloud Infrastructure

In 2010, 59 percent of IT buyers included green criteria in their evaluation and selection of IT equipment, up from only 25 percent in 2007. [9] However, energy efficiency outdoes all other design-for-environment characteristics, such as recyclability, reduction of toxic chemicals, reduction in packaging, and longevity. The cloud-based infrastructure attempts to follow this same approach.

Cloud computing can be a vital catalyst for an enterprise IT organization's push to be greener. Further, the ―green cloud can also contribute to meeting critical operational goals:

- *Reduce costs.* Consolidation means fewer servers, which in turn means lower cooling and space requirements, which means lower energy costs.
- *Fulfill regulations.* By tapping more efficient and therefore lower-emitting resources, cloud customers can reduce their carbon emission and be better-positioned to meet regulatory standards.
- *Improve resiliency.* Consolidation and improved utilization create more space, more power, and more cooling capacity within the same facility. Tapping into the cloud offloads the management of those resources to the cloud provider.[9]

III. CONCLUSION

Green computing minimizes the energy consumption of the organization. Appropriate legislations, regulations, user education and awareness and recycling are some of the solutions to reduce power consumption and minimize environmental waste. Government can discourage the irresponsible disposal of computer hardware that generally lack biodegradability by putting in place a proper ICT waste management body and also giving low tax incentives to industries that do not practice Green computing.

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.[8] In enterprises, we must be smarter about the technology tools we choose to use. This requires for all of us to understand the possible adverse impacts of the tools and understand how to reduce these impacts, taking action to implement justifiable efforts in practice. Presently, with a greater concern for the environment, green computing is well practiced in most institutions and industries, and has contributed substantially to reducing carbon emissions and conserving the environment. Office staff, managers and all other stake holders can start by making small contributions towards sustainability implementing at least the concepts and guidelines discussed here. Such small contribution can lead to a substantial improvement in energy efficient and environment friendly enterprise structures and save time, money and resource on maintenance.

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