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# A Review on Green Information Technology (Virtualization)

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***Abstract:*** Green computing or green IT, refers to environmentally sustainable computing or IT. Green computing is defined as "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.

We love our computers for all the ways they make our lives (and the world) better -- the wealth of knowledge (and democratizing force) of the Internet, the instantaneous communication, the sophisticated tools that help us work and create and share. Green computing is the study and practice of using computing resources efficiently. The plan towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings.

***Keywords:*** Computing, Server, Virtualization, power cooling, software migration, Carbon

## I. INTRODUCTION

Green computing is the study and practice of using computing resources efficiently. The primary objective of such a program is to account for the triple bottom line, an expanded spectrum of values and criteria for measuring organizational (and societal) success. Modern IT systems rely upon a complicated mix of people, networks and hardware; as such, a green computing initiative must be systemic in nature, and address increasingly sophisticated problems. Elements of such as solution may comprise items such as end user satisfaction, management restructuring, regulatory compliance, disposal of electronic waste, telecommuting, virtualization of server resources, energy use, thin client solutions, and return on investment (ROI). 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. 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.

## II. VIRTUALIZATION

Virtualization refers to technology which uses a hard-ware resource, like a server or desktop, to run multiple virtual machines. This allows users to consolidate physical resources, sharing the resources of that single computer across multiple environments.

Traditional server deployments (one server per physical machine) run at very low CPU utilization levels of 5-15% on an average. Even desktop computers are heavily underutilized in terms of average CPU utilization for the duration it is provided on. However, on an average, a computer that is idle still consumes about 60-90% of the power that it does when running at full utilization. Also, considering the additional environmental impact on the other stages of its lifecycle, it is essential that the utilization is increased to compare to more optimal levels.

Virtualization is a technology by which the hardware resources are separated from the operating system and applications by a software abstraction layer. Thus, multiple under-utilized computers can be virtualized into a single physical computer. By abstracting the different components of the traditional computer, virtualization can help achieve a more rationalized distribution and utilization of the various resources.

Since resource utilization is measured as the ratio of useful work done to the amount of resources consumed, virtualization helps reduce the environmental footprint at all stages.

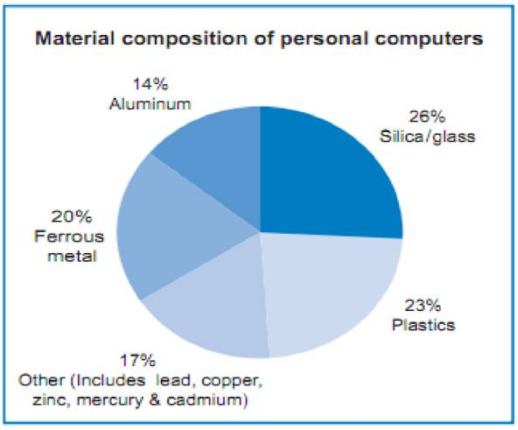


Figure 1: Material Composition of Personal Computers

## III. HOSTED DESKTOP VIRTUALIZATION

Hosted desktop virtualization is also known as a virtual desktop infrastructure (VDI) solution is based on the client-server model where individual desktop images are hosted on virtualized server environment. Thus, VDI separates the personal computer desktop environment (client) from the physical machine (hosted server). Using desktop virtualization technology, a virtualized desktop OS (hosted on a centralized server) can be accessed by variety of devices including traditional PCs, thin clients or even certain handheld devices.

## IV. GOALS OF GREEN COMPUTING

The goals are similar to green chemistry; reduce the use of hazardous materials, maximize energy efficiency during the

product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste. The goal towards green IT should include new electronic products and services with optimum efficiency and all possible options towards energy savings.

Figure 2: Recycle

## V. SERVER VIRTUALIZATION

Server virtualization is a technology by which multiple virtual Machines reside on a single physical machine. An abstraction layer called the hypervisor or virtual machine monitor resides between the hardware and the guest OS and takes care of the hardware resources scheduling and management.

The resources that are abstracted include the processor (CPU),the primary (RAM) and secondary (HDD) memory and other hardware peripherals. The applications that run in their separate virtual machines (VMs) are completely oblivious of the fact that they are sharing the hardware resources with other virtual machines.

The advantages of having applications run in separate virtual machines as opposed to running them in the same physical machine are many including optimal resource usage, better application security, stability and performance .

Many factors need to be considered while deciding when to adopt server virtualization as an enterprise wide strategy. These include the costs associated with migrating legacy systems, training admin personnel, regulatory and data security considerations and new hardware and software costs. However, from an environmental point –of-view, virtualization can and should be adopted wherever possible with the deciding factor being optimal usage of the computing resources.


Figure 3: Server Virtualization

## VI. VIRTUAL WORK PLACE

- Easy for disrupted workers to switch to a new work location.
- Large numbers able work from remote locations for extended period.
- Maintain communications with customer's partners, suppliers, and co-workers.
- Capabilities include automatic notification, roll calls, bulletin boards, express directory, instant Messaging, call redirection, and remote desktop access.

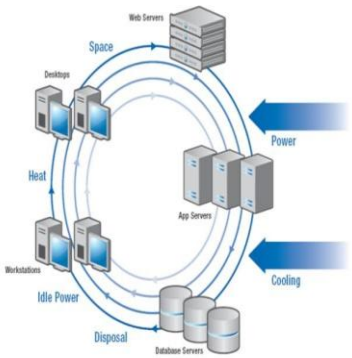


Figure 4: Virtual Workspace

### *A. Green Benefits of Virtualization*

Virtualization helps reduce the ecological impact at all stages of the computer lifecycle.

### *B. Manufacturing and Disposal*

Virtualization reduces carbon emissions due to lesser amount of materials consumed in manufacturing. For instance, 'zero clients contain no processor, memory or other moving elements (hard disks).

E-waste reduction, as opposed to e-waste recycling, is a step towards greener environment. Zero clients can last for 8-10 years as opposed to 3-4 years for a conventional PC.

### *C. Packaging and Shipping*

A thin/zero client(used in hosted desktop virtualization) weighs roughly 10-20% of a normal desktop PC. Packaging material requirement for a thin client is around 2.2-4.4 lbs while it is 5-10 kgs for a PC. The reduced size of the thin

clients also cuts down the carbon en=missions caused in transportation.

***D. Operation***

Electricity consumption of a thin client (5-15) is less than 10% (150-200W) that of a PC. Server virtualization can reduce electricity consumption as well as cooling requirements in data centres, thus reducing both costs as well as carbon emissions.

## CONCLUSION

However it is vital that effective governance and monitoring policies are put in place to ensure that post virtualization the desired optimization is achieved. For instance without effective governance, virtualization might only help in moving the server sprawl problem from the physical to the virtual domain.

The IT department also needs to measur the green benefits that accure from their virtualization efforts in the organization. This data is vital to articulate the savings to technical and business decision makers in the organization

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