A Transition Toward Green IT: An Initiative

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Abstract The computers and hence computing have become an integral part of human lives in the present Information Age. The increased use of computers enables tedious tasks to be performed in a hassle-free and faster manner. But, this ever-increasing use of computing devices is taking its toll on the environment both in terms of resource utilization and its quality. Green computing is an environmental-friendly way and the current trend in the field of computing. Also, known as green IT, it paves the path to a greener version of computing. A slight transition from the conventional IT or non-green IT can make a huge difference and reduce carbon footprint to a great extent.

Keywords Green computing · Green IT · Energy efficiency

1 Introduction

Green computing is a study mainly concerned with the efficient use of resources. The primary goals are to reduce carbon footprints, to make computing more energy efficient, and minimize e-waste disposal. Computing involves various phases from its design [1], manufacturing to its end use and finally disposal [2]. Incorporating small changes at each phase can bring a huge difference to the adverse effects of IT on the environment. Minimizing power usage is another aspect that can substantially contribute in making computing less hazardous for the environment. Thus, green computing is not a technology but simply a transition from a conventional way to a new greener way. Modern IT or modern computing involves a lot more people, infrastructure, organizations [3], and money as compared to what it used to be 10 years back, and there is a continuous increase in these figures. Therefore, this

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transition must be systematic and must address many issues such as end user satisfaction, management restructuring, regulatory compliance, disposal of electronic waste, telecommuting, energy use, thin client solutions, and return on investment (ROI). The spectrum of IT industry is very huge as compared to any other industry and so are its effects. There is a need of transition so as to minimize the adverse effects of the IT industry on the environment. Green computing involves developing greener hardware as well as greener software.

2 Phases of Computing System

Hardware involves different phases from its designing to its disposal which is known as the life cycle of a computing system. Figure 1 depicts the typical steps in the life cycle of a computing system.

The major steps in the life cycle of a computing system are:

2.1 Designing [3]

It is an important phase to be considered in the life cycle of computer systems in general. The system should be designed such that it can be used, retired, and disposed of in an environmental-friendly way. The following points are required to be kept in mind to design such a system:

Support, repair, and upgradability: A system should include as many elements as can be repaired. Instead of replacing the complete system, it can be upgraded as and when required.

Less power consumption: Power consumption is a factor that affects both users' expenses and the environment. Systems running on less power definitely lead to a win-win situation for the users' pockets and the environment as well.

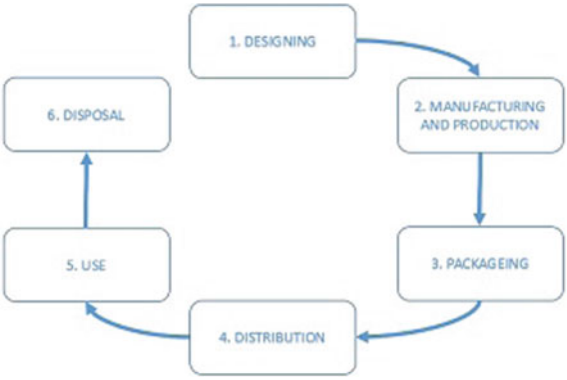

Fig. 1 Life cycle of computing systems

2.2 Manufacturing and Production

Materials used in the production of the system should be such that these can be recycled [4]. Moreover, the materials should be non-toxic so that an environmental-friendly disposal is possible.

2.3 Packaging

Multiple computers can be packed together rather than individual packing. Moreover, there can be a provision of taking back the packing material by the vendors or shipping agencies so as to reuse at least non-recyclable material. A user manual is also a part of the packaging which adds up to the overhead of disposal; manuals can be made available online to reduce the burden.

2.4 Distribution

Smaller and lighter products should be encouraged as it reduces CO_2 emissions and transportation costs. Transportation by sea is a greener way of transportation than air transportation.

2.5 Use

Efficient product design and power management reduce power consumption. Server center optimization also reduces energy used by these servers.

2.6 Disposal [3]

Many parts of the IT equipment can be reused as it is or with slight modification. Some other parts can be made ready for a new life cycle by recycling. Machines can also be refurbished or upgraded to be used again rather than disposing it off.

3 Minimizing Power Consumption

3.1 Hardware

Power is the most crucial component of the IT industry. It is as important to IT equipment as food to us. Every IT device needs power in the form of electricity to function. The total power available to us is limited and over-usage may have a huge impact on the environment and the budget of the user as well. The cost factor is huge for organizations with a large number of machines. Thus, power consumption management is required to make optimized use of power.

Reducing redundant data: In larger organizations where the data is distributed over more than one sites, data is backed up regularly. In this process, the same piece of data is backed up several times making redundant copies of the data, consuming large amounts of bandwidth and storage space and hence consuming more power. A tool to eliminate duplicate data can be implemented. This will reduce the burden on the bandwidth and data would require less storage space. Moreover, fewer amounts of data can be dealt with by using a lower performance, energy-efficient disk.

Virtualization: Virtualization [5] is an energy-efficient technique which is both robust and cost-effective [6, 7]. It enables the users to work without worrying about the underlying hardware. Users need not be worried about the failure of the infrastructure; even if some components fail, users can still be able to use the services of the server. It also eliminates the need for individual hardware disks for every user. Lesser number of disks directly implies less energy consumption.

Storage area network (SAN): Storage area network provides a huge power saving over directly attached storage. Scaling is efficient and logical in SAN. Only a disk needs to be added to increase the storage capacity in SAN in contrast to adding a file server in case of directly attached storage.

3.2 Software

Improving network algorithm: In big organizations where large numbers of computers are connected over a network, network delay and bandwidth utilization is a matter of concern. By optimizing the network/routing algorithms, these delays can be minimized and bandwidth utilization can be maximized. With improved bandwidth utilization, more amount of data can be transferred in less time thus minimizing overall "ON" time of the network and hence less power consumption.

Improving scheduling algorithm: There are various types of resources involved in the computing environment. These resources are to be scheduled among different users. The scheduling becomes critical when the system involves a large number of

users. Long idle time and poor throughput result in longer waiting state of the processes which directly implies more power consumption. Resource scheduling algorithms can be optimized using various approaches, hence, optimizing/minimizing power consumption.

3.3 Basic

Switch off the system: The system should be shut down and power should be switched off when the user is away for a longer period of time. This approach is very basic and simple but user's ignorance to this basic approach wastes a significant amount of energy.

Low power mode: The system should be kept on low power mode when not in use. This simple step contributes in saving considerable amount of energy.

Maintain screen resolution: A higher screen resolution consumes more battery power as compared to lower screen resolutions. Battery-enabled devices can have a longer battery life by choosing an optimum screen resolution.

4 Conclusions

The world has started moving slowly toward green IT, and there is a need of a transition from the conventional IT to a greener way on a global scale. The small steps, as mentioned in the paper, taken at the root level may curb the problem of carbon footprints to a greater extent and will contribute toward a better environment. More stringent rules [8] are required to implement these rules in a stricter way so as to attain a positive transition.

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