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Evolution of Green Computing and its significance in IT Sectors

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Abstract: The concept of "Green Computing" gains its insight over the past few years due to the increased use of computers at work places as well as for domestic purposes. This is due to the necessity of the usage of computers on daily basis for serving various purposes which leads to the increased power consumption thereby increasing the carbon content into atmosphere. Due to the rapid growth of IT industries the energy consumption shoots up hence the technique called as "Green Computing" comes into role. The major objective of green computing is to maximize the efficiency of the products of IT and to manage the recycle process of the wastes and the fallow goods and chattels out of the factory/organization. Hence with the help of green computing resources of IT can be efficiently maintained and managed throughout its lifecycle in the facets of being eco-friendly, compatible with environment conditions, preserving energy and etc., This paper aims at presenting the overview of green computing and how it gets differs from other computing techniques.

Keywords: Green Computing, Energy Efficient, Eco-Friendly

1. Introduction to Green Computing

The term "Green Computing" refers to the usage of computing resources and IT infrastructure efficiently. It is also known as environmentally sustainable computing [1]. The main goal of green computing is to minimize the energy consumption and cost of the IT resources thereby maximizing the lifetime of the resources efficiently [4, 5] by adopting green IT products, services and applications with minimum impact on the environment [3,10,12]. The field of green computing focuses on the issues which includes **green infrastructure** – renewable power sources, cooling systems, **green hardware** – multicore systems, energy efficient server, **green software and applications** – intelligent load distribution & CPU switch-off. On the other hand, the environmental benefits of green computing are achieved through the deployment of energy efficient systems with reliable and prevalent facilities like **green design**, **green manufacturing**, **green use** and **green disposal** [6].

a. Trends and Challenges in Green Computing

Maximizing the performance and lifetime of the computing resources while minimizing the energy consumption and toxic emission is the major threat on the environment that needs to be taken into consideration [9]. To do so, many strategies [3, 4, 11, 12] have been adopted by organization which includes,

a. Energy Conservation Techniques- to conserve power computer systems that are not in use should be activated with the hibernate mode and stand-by mode. Apart from this, usages of handheld devices have been increased replacing the use of desktops because PC desktop consumes 80% more power than handheld devices [11]. Other means to conserve power is to develop efficient algorithms to complete the computational task by utilizing the reduced number of resources.
b. Virtualization – it is the technique of running several computer systems on a single physical machine. The advantage of adopting virtualization is that the new applications can be deployed with the same amount of hardware, space and cooling facilities by the organization.
c. Repair, re-use, recycle and disposal – the toxic emission from the e-waste should be eliminated/minimized by recycling and reusing of outdated IT resources will save the energy consumption.
d. Optimization of Data Centers – data center being the main source of computing it consumes more power in any organization. To optimize the utilization of data centers necessary steps need to be taken by choosing the appropriate and efficient equipment, secondly the current and future requirement of the data center for designing the cooling system. Lastly, loads of the electrical system needs to be considered while designing.

b. Issues of Green Computing

Issues that are need to be considered in the field of green computing [8, 13] are,

a. Estimating the return of investment (ROI) by using the green IT products. A drawback is that it takes considerable amount of time in exhibiting the real pros and differences of using green resources.
b. E-waste Disposal – it is the biggest challenge since the components used in green manufacturing should be chosen carefully such that it should not be hazardous to the environment once after its lifetime.
c. Long run Process – manufacturing green products such as IC chips with high performance and efficiency with low power consumption takes lot of time as well as effort provided with skilled set of people to achieve the goal of green.

c. Difference between Green Computing and other Computing techniques

The differences between green computing and other major computing techniques have been presented in Table 1. as below on various dimensions.

Table 1. Comparison of Green Computing with other Computing techniques

Green Computing	Cloud Computing	Grid Computing	Mobile Computing
Definition			
Green Computing can be defined as a field of computing that involves both computers and technology which are responsible for change in environment.	Cloud Computing is called as Internet Service which furnishes the necessary computing resources to the users.	Grid computing can be visualized as a group of computers which are connected over a network performing various tasks like e-commerce, solving complex problem in a dedicated fashion	Mobile Computing is a technology which involves communication of mobile devices without any single point of attachment.
Objective			
The main concept focuses on building computing and data centres with low power consumption and eco-friendly.	The main concept of Cloud Computing is where an application doesn't access resources directly; rather it accesses them through a service over the internet.	The main concept behind grid computing is that it involves virtualizing computing resources to store massive amounts of data.	The objective of mobile computing is to develop system and application level software for small, battery powered terminals equipped with the wireless network connection.
Significance			
Being efficient as much as possible with great concern for the environment.	Being flexible in terms of scalability so that instances use only those resources they really need and not more.	Being able to scale up and down in order to be able to handle any possible workload equally efficiently, regardless of resources and the environment.	Thus, mobile computing is the ability to use computing capability without a pre-defined location and/or connection to a network to publish and/or subscribe to information.
Advantages			
• Reduced energy usage • Conserves resources which means less energy is required to produce, use, and dispose of products.	• Cost efficiency • High Speed • Excellent accessibility • Back-up and restore data • Manageability	• Optimal usage of installed CPU power • Cheap • CPU-intensive tasks can be processed • Reliability	• Increase in Productivity • Entertainment • Portability

Disadvantages			
• Quite costly. • Some computers that are green may be considerably underpowered. • Rapid technology change	• Vulnerability to attacks • Network connectivity dependency • Downtime • Limited control	• Complex software needed (administration of the grid, distribution of • tasks to the computers attached to the net) • Not all tasks are suitable for grids (complex parallelism)	• Quality of connectivity • Security concerns • Power Consumption

Discussion

The concept of deploying Green Computing has gained significance in past few years and it becomes more important due to the impact of emission of carbon content [2] and global warming on the environment. Apart from these ecological factors, green computing has also scored high in reducing the energy consumption by the IT resources. The future trend of green IT should involve the development of computing resources which are efficient in terms of utilizing the services and electrical power. Further research is required to cover the issues of green computing efficiently. One such move towards green computing is Green Cloud Computing [7] which involves the usage of cloud computing facilities in green manner to avoid the negative impact on environment as well by utilizing the IT resources efficiently.

Conclusion

The move towards green computing has perceived its importance in past few years. Lot of effort has been put forth in developing eco-friendly technologies by the researches and organizations widely. Several steps like virtualization, repair, reuse, recycle and disposal of resources in improved manner, data center optimization have been initiated towards achieving the goal of green computing by the organizations. Significant improvement in energy efficiency in utilizing the computing has been witnessed and more research is to be done to develop the computing units that go green in future.

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