

A Preface to Green Computing and its Issues

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Abstract: This paper shows the critical problems that the environment has to face due to the negligence of human beings. This may be due to carbon footprints of hardware devices, unethical disposal of e-waste, energy dissemination in the form of CO₂ release and many other factors. The paper has proposed solutions in two major areas: effective utilization of resources which is called load balancing and effective use of databases to reduce carbon footprints in the form of green databases.

Keywords— IT, Green Computing, Load balancing, Virtualization, Data deduplication

I. INTRODUCTION TO GREEN COMPUTING

In this era of technology, every small task is being automated. Innovation is necessary for existence but day by day, our environment is getting contaminated by the use of various perilous materials. Obliquely, we are inviting problems to our home. In this cutting edge time of globalization, PCs assume a fundamental part in each field. They are not just utilized as a part of workplaces but additionally utilized at home and this requires a huge amount of electricity as well. Every PC in turn produces a huge amount of carbon dioxide consistently. PC parts contain parcels of dangerous materials. The increased carbon in the atmosphere impacts solid health issues in regular life. Now the time has come to save and devise environment sustainable technology, addressing the necessities of society in ways that can proceed inconclusively into the future without harming or exhausting normal assets. In this scenario, we need a mechanism that is required for moving towards green computing and reduce energy consumption of ICT and further Using ICT to reduce it [1].

Definition- “ 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”.

II. MOTIVATIONS TO GO GREEN

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A. Go Paperless in Eco-friendly way

We know that production of paper requires cutting down trees which disturbs the ecological balance. Adapting to electronic means of storage and communication reduces paper consumption to some extent. Use of Emails, Google Docs, DropBox (rather than maintaining physical files) and text editors for correcting mistakes in electronic documents is a clean way to save trees. Apart from saving paper, attention should be paid to the use of electronic documents in an eco-friendly way. For example, while taking printouts, one must ensure the use of both sides of paper as well as the use of one-sided printed paper for rough work. Also using a small font size with little margins and regular recycling are good practices towards going paperless in an ecological way.

B. Energy utilization

Nature calls for utilization of energy in an ecological manner. The best practices involve turning off computers when not in use or just turning on power management options like setting monitors on hibernating mode or sleep mode when in idle state, setting dark colored or black colored backgrounds of desktops, using black search engines like Blackle.com, DarkGoogle.com, Jabago.com, Earthele.com, etc. These options lead us to a step forward towards combating global warming.

C. Reduced Power Consumption

Higher power utilization comes with not only high electricity bills but also additional cooling system requirements and uninterrupted power backups which add up to the infrastructural costs. Blade servers serve the purpose of space utilization. In spite of the fact that blade servers give more computational power over less rack space, they affect the environment in the form of CO₂ emanations because of high energy utilization. So reduced power consumption is another reason for going green.

D. Bring balance in nature

Greening is the need of the day as with the increasing population, the natural resources are getting exhausted and for survival we need to adopt green ways which do not affect the environment negatively. Scientists today are putting their efforts in this direction. Cheap Hydroponic systems are examples of such an idea being implemented for growing food in a natural way and in less area as compared to real farming practices. Likewise, the energy dissipated from data centers in the form of heat is supplied to nearby swimming pools for heating water of the pool. Such ideas when implemented prove to be the best alternatives for performing daily tasks without affecting nature.

III. MAJOR AREAS

A. Load Balancing in Data Centres

Cloud has become largest pool of resources like CPU, storage, network bandwidth etc. and data centres are the fundamental part of its framework. The Cloud computing model runs a huge number of applications, some of them run for a shorter period of time (e.g. serving requests of net applications like e-commerce and social networks portals with transient workloads) and others execute for longer duration of time (e.g. simulations or giant information set processing) on shared hardware platforms. The challenges that a data center commonly faces are: **on-demand resource provisioning and allocation** of resources in response to **time-varying workload**.

Another big challenge is to fully utilize the resources. Only 5 to 10 percent are in computing rest are sit idle.

Virtualization- The rate by which energy cost is increasing and ecological balance is getting impacted from different sources, extra efforts are required in terms of computing. Cloud actually holds together many technologies in a single platform and this is achieved by the process of virtualization. The virtualization focuses on productive utilization of accessible assets.

In a simplest term, virtualization enables to create a virtual infrastructure, having at least two PCs, running on totally extraordinary different conditions or different operating system, on one physical server. In the context of data centers, virtualization means creating a virtual set-up that allows many operating system and applications to scurry on a slighter number of servers so as to reduce energy consumption and cooling requirements for data centers.

For example, running Linux and window operating system on one server.

Load Balancing- It is one of the power pack techniques in the field of cloud computing moving

towards greening. Its main goal is to achieve green by balancing the load among the nodes and to reduce the resource consumption which in turn reduces the energy consumption and carbon consumption rate [3]. One of the biggest challenge in data center is the frequent enhancement of cloud server. It actually worries with the stack adjusting of cloud datacenters to increase efficiency of the machines and shortage the number of idle host machines which would lead to achieve the idea of green infrastructure.

Need of Load Balancing

Problem with load balancing in Data center arises many times due to unfair situation like the number of host machines and each host machine with distinctive extra ordinary load need to fulfill clients's request., the load distribution may vary according to each host machine such as usage of CPU, memory storage and network bandwidth utilization. Too heavy load means machine has exceeded its usual capacity which affects its efficiency. Such kind of situation generally occur in data centers due to changing behaviors of application services running on virtual machine of the host machine. Sometimes client applications change their resources request(eg, RAM extension, CPU usage, Storage and Bandwidth utilization).This makes the host system unprovoked and the system in turn utilizes load adjusting procedures thereby circulating the additional workload of the overburden host of the data center to the entire cloud's host having light load [3].The elevated client fulfillment and the higher asset requires better workload advancement strategies. It is additionally required to enhance the general execution of cloud framework.

Load balancing techniques mainly guarantee dispersion of cloud assets decently and enhanced productivity among running cloud services. Consequently, the decrease in quantity of dynamic host machine not just backs the green computing hypothesis by diminishing the power utilization, but in addition diminishes the cost of the cloud administration [3].

site accessible by adjusting the network movement [2]

Apart from the previously mentioned factors, load balancing is additionally required to accomplish Green computing in clouds which should be possible with the assistance of the accompanying two factors:

1. Load adjusting helps in abstaining from overheating by adjusting the workload over every one of the hubs of a cloud, henceforth decreasing the measure of vitality devoured [6].
2. Energy utilization and carbon outflow go as one. The more the energy expended, higher is the carbon impression. As the energy utilization is lessened with the assistance of Load adjusting,

so is the carbon outflow helping in accomplishing Green computing [6].

B. Green Database Evaluation

While dealing with huge amount of data in everyday scenario, we need to store, manage, search and transfer bulk of the data by using databases, web engines, social networking sites and mail servers over the Internet or on a company's intranet. Such data processing tasks consume high energy and disseminate lots of heat that add up to the carbon footprint of a datacenter. A better option is to go for 'Green Databases'.

"A green database refers to the repository of data with minimal effect to the environment. It is an environment friendly database unlike the present day databases"[11].

Significance of Green Database: Sooner or later by the end of this decade, most companies will adopt Green IT as environmental factors are important in planning IT operations. The green wave has just started to rise. A company's purchasing processes would include green criteria before starting a new setup. Software and application efficiency can be significant for green IT.

i) Energy Saving: Volumes of data over the clouds are securely managed in huge datacenters located all over the world. Storage of such bulky data in datacenters is an issue as the increasing size of databases requires a tremendous increase in power consumption. It calls for saving the energy consumption, as every watt is correspondent to money. A benchmark on which to begin estimating the effect of an organization's energy-saving initiatives in the green IT zone is required. Energy efficient software can be used to reduce database transactions. Every individual can also contribute towards saving energy by simplifying the complexity of database queries and thereby reducing the number of database transactions. For example, instead of searching the whole database for a specific result, we should go for a least complex query.

ii) Efficient Data Storage : Multi-level storage is one of the common ways to improve the storage efficiency. By implying **Data deduplication**, which is also called intelligent **compression** or **single-instance storage**, the duplicated copies of data are removed thereby reducing storage drives to some extent. A single distinctive instance of the data point is truly preserved on storage media, like disk or tape. Duplicate copies of data are replaced with a pointer to the distinctive data copy. It can be better understood with an example: when we take backup of our email accounts, it creates different instances of the same file attachment which in turn requires more storage space. By data deduplication, a single instance of file attachment is truly saved and every resulting instance is simply documented back

to the one saved copy. With this technique, the storage requirement is reduced to one-tenth of original requirements.

C. Future Extension for Green Databases [16, 17]

i) Green aware database system design: Research in the area of database systems is not focused only on database workload scheduling and hardware settings; rather it should address other issues like implementation of green query operator, query optimization and its execution. For further research, existing system components must be reviewed and new components must be proposed. Basically, two areas in Database Management Systems(DBMS) attract researchers: achieving query optimization and designing query or task scheduler. Apart from these areas, there are other challenges to be dealt with like designing integrated solar panels and battery provisioning.

ii) Green Databases for IoT applications: The design of the ReinDB system depends on the workload distribution and green supply prediction. This work can be extended to automate the monitoring on brown and green energy supply. The atomicity feature of green database will enable it to be used for advanced IoT applications for data storage.

iii) Computation with Green energy supply: The computational costs within a data centre include applying techniques for running optimized queries at larger scale rather than on a single database server. Alternate means of supplying renewable energy are water and heat. We have to consider the other features as well for continuous green energy supply like economics and charging/discharging efficiency as we cannot rely on batteries only for data centres.

iv) Using Green Database with the Power Grid: The electricity supply from Power Grid is a mix of green and brown energy. The proportion of these two supply sources depend on the area or domain where the electricity is getting consumed. Smart grids are the best alternatives to the users to decide upon this ratio. With the use of smart grids, users would be able to adjust the required computational efforts with actual green energy supply.

IV. CONCLUSION

With the advent of technology, we are heading towards the situation where we would have to pay for the playing with the mother nature. To cope with this state, we have to think rationally towards saving the environment, be it technically or casually. Moving a step further, when we discuss about data centers, the main challenge is to properly utilize the resources along with job scheduling techniques, which can be attained by Load Balancing techniques. Further, for minimizing the use of brown energy and promoting green energy applications we have

proposed green database systems which would prove to be a revolution in the era of technology and would aid in monitoring the supply of green energy for execution over database servers. For small scale implementation, green databases are best suited. In future, green database servers are supposed to be implemented for large scales like for clusters and in data centers.

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