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Energy Optimization of a Green Data Center for the Sustainable Development

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Abstract: ***A data center is a competence calm of networked computers and storage that different industries use to sort out, process, stock up and spread huge amounts of data. Data centers are central part of computational systems. An industry naturally depends heavily upon the purposes, services and data contained within a data center, building it a central point and vital asset for everyday operations. In this paper our focus is on energy optimization for a green data center. A green data center is a warehouse for the storage, management, and diffusion of data in which the automatic, lighting, electrical and computer systems are designed for highest energy efficiency and smallest amount environmental impact. In this paper, we are going to introduce an energy-efficient data center by adding server association and idle logic way of the network. Our expected logic approach allows dropping power consumption of network devices by speedily turning off sub-components when no operations are performed, and by re-cycling them up when the system receives new work. The consequences show that our ideal logic approach reduces the consumed energy of network devices as well as servers.***

Keywords: Energy_efficiency; Re-cycling; Virtualization; Cooling System; Server; Clouding;

1. Introduction

Information and Communications technology is increasing at a spreading rate and has direct contact over the world. Data centers are the main segment of IT business organizations.[1] Most of the Internet traffic is determined on data centers as supreme calculation and storage space is moving into the cloud that gives the facilities of unified warehouse for store, management, networking and spreading of data. These data centers consume terrific amount of energy. Most of the data centers are disturbed with thousands of servers as major components. [2].These Servers emits Carbon foot prints thus raising the requirement of more green computing techniques. These techniques require attention for formal energy consumption issues. Current studies basically focus on the existing approaches and challenges for Data center optimization to achieve Green Computing.[3]

This paper presents a systematic overview on virtualization, cloud computing and energy efficiency methods as well as drop of carbon emission from data centers. This increases operational cost and also releases large amount of carbon that is hazardous to environment.

Data centers are core of computational systems. They are highly efficient and consumes large amount of power. This increases operational cost and also releases large amount of carbon that is hazardous to environment. [3]Due to rising temperature across the globe and global warming caused due to carbon footprint, it is imperative to make these centers eco-friendly. Green computing makes way for such innovations as it relates power usage in eco-friendly ways. Energy consumption related to ICT infrastructure is fixed by profiling workable methods to improve existing ones [4].

This work exposes the available techniques for optimizing energy in green data centers. Different cooling methods and deployment of energy efficient servers have also been addressed. Optimizing energy in Data centers is becoming an important aspect of research and this paper presents a review on various techniques or method that has been proposed by computing researchers and scientists. It also discusses the role & fundamental framework and security issues of Green data centers. It also focuses on basic challenges faced by green data centers.

To bring green technology, energy efficient methods in manufacturing of computer systems and related resources will be highly helpful. Further use of eco-friendly equipment can save large amount of energy. This will require the implementation of techniques to increase energy optimization while maintaining the performance metrics. Green computing is a revolutionary technology for cost – effective, low carbon emission and operational benefits. The benefits and importance have been discussed by International Federation of Green and Green ICT sustainability to bring practice of environment sustainable IT. Green IT refers to the study of the manufacturing, using, designing, disposing of computers, data centers, servers, monitors, printers, storage device etc. in a more efficient and effective way with little or no impact on the environment as stated [5].

Data centers consumes energy in critical computational systems such as severs, networks & storage, cooling systems, hosting other devices, conversion of power between alternating and Direct current including Power Distribution Units.Optimization of data centers not only aims to provide tools and technique for this effort, but also to provide excellent IT services.Optimization of data centers requires reducing heat emission of system so that less energy will be utilized in cooling of systems, using of solar system,

implementation of components and virtualization.This section discusses various ways of optimization of data centers.

Green Computing is a process to reduce energy consumption by computers and other ICT systems for environment friendly ways. Green disposal: It is about reusing old computers. Another approach is green design. Green design is to design environment friendly computers, servers, and components. Green manufacturing refers to the production of electronic components, computers and other subsystems without impacting environment. This is our motivation to reduce energy loss through green computing as well as using green data center.

2. Background

Mango Data Centers as a group consume a staggering amount of power and their appetite is growing. An August 2017 report by the United States Environmental Protection Agency estimates that U.S. Data Center power usage doubled in 6 years, consuming 61 billion kilowatt hours (kWh) of energy by 2016. The report additionally projects that, unless Data Centers make efficiency improvements to both facilities and IT (Information Technology) components, that power consumption will reach 100 billion kWh by 2017. The European Commission, meanwhile, in the written introduction to its Code of Conduct on Data Centers (discussed elsewhere in this chapter) estimates Western European Data Center consumption at 56 billion kWh per year in 2007, reaching 104 billion kWh by 2020. Such dramatic growth in consumption can be attributed in part to the overall proliferation of technology and Internet usage throughout society. More emails, instant messages, web searches, online financial transactions, and video downloads occur today than just a few years ago. More servers, networking gear, and storage devices are needed to facilitate that burgeoning Internet traffic—more in quantity, more in performance, and therefore more in power consumption.[9]
Moreover, these ratios are increasing resulting from the recent data center deployments. In addition the Efficient Servers project evaluated the increase of electric energy consumption of servers in Western Europe at 37% between 2013 and 2016.[8] In 2007 the energy consumed in data centers in Western Europe was 56 TWh and is projected to increase to over 100 TWh per year by 2020 [5]. This will represent about 7 times the capacity of the currently under construction new EPR nuclear reactor in Olkiluoto, Finland. As the price of electricity is continuously augmenting1and the environment aware operation of the companies is becoming more and more desirable by the customers, the energy efficient operation of data centers is required both from a financial and a social viewpoint. Therefore, the operators of the data centers are interested in more energy-efficient data center infrastructures and operations. This is justified by the press releases of leading IT companies; there is a new statement in almost every week.[7]
Data centers have become prevalent in the literature in the recent years; tremendous works have been made towards reducing the energy consumption of the data centers. In fact, a comprehensive survey of the energy efficiency of the data centers has not been published yet. Therefore, in this chapter we summarize the proposals dealing with the energy consumption and its reduction possibilities. The achievements are presented by the following areas. The energy consumption of data centers' hardware infrastructure is reviewed in the next section problem formulations. It also discusses middleware proposals, which optimize the energy consumption of data centers. Cooling and heat control play a crucial role in the data center facilities: they are necessary to precede hardware failures; however, significant amount of energy is utilized by this equipment. Thus, energy efficient cooling solutions are summarized in methodology. Finally, the properties of data centers' network infrastructures are overviewed because the energy consumption of the switches and routers is not negligible. The reduced energy areas are reviewed in this paper is illustrated in Figure 1.

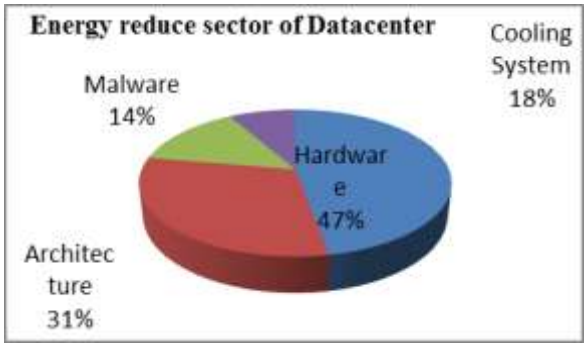

Figure 1: Energy reduce sectors of Data center

We hope this survey will serve as a ground that will help the research community address the open issues of the topic of data centers' energy efficiency.

Also, at many companies, Data Center power and cooling capacity are seen as unlimited resources, so few barriers exist to inhibit demand. If you allocate a budget each fiscal quarter to buy servers and there are no restrictions, why not buy the fastest machines with the most processing capability you can afford? Unfortunately, that top-end performance often translates to top-end power demand and heat production.

Another likely contributing factor is the shrinking form factor of Data Centre equipment. Today's server models are physically smaller than yesterday's, allowing more of them to be placed in each Data Centre cabinet than in years past. Even if a new machine consumes less energy than its predecessors, and not all do, the fact that you can install more equipment in the same physical space means that more overall power is consumed.

3. Methodology

In our proposed model a huge amount of energy loss will be reduced according to optimizing of green data center like virtualization, integrating services with cloud computing, optimizing use of power and environmental optimization by improved cooling system. Figure 2 illustrates our proposed ideal approach.

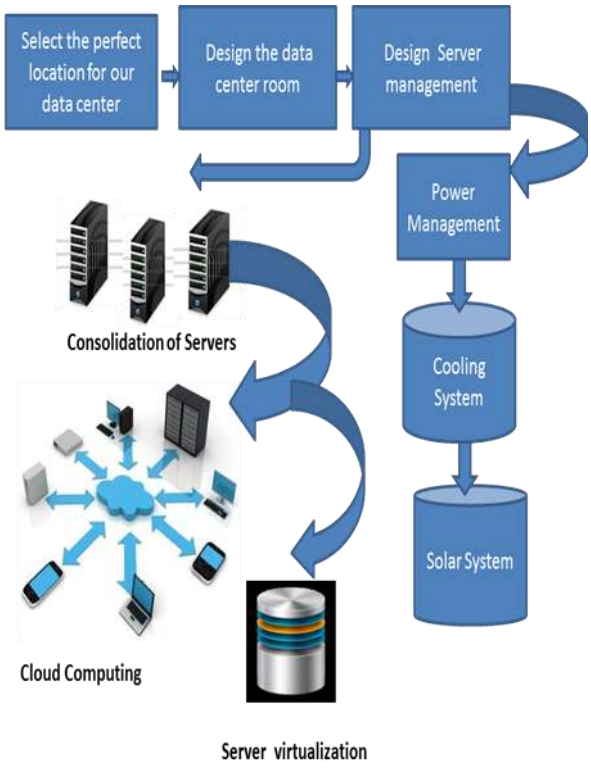

Figure 2: Proposed model for green data center

At first we are going to select a perfect location for our green data center. Our data center can be located at places where plenty of such resources are available well maintained and well monitored data center can result in direct energy optimizations,.E- waste minimization and developing thin client devices, these can contribute a lot in the process.

The most important step is designing room. Servers should be managed within racks. Proper ventilation is needed. In this case we can use free air ventilation instead of Air Conditioner. Physical security of hardware should be managed in our data center

3.1 Virtualization

Servers consumes great amount of energy and also generates a substantial amount of heat. Virtualization is software defined network technology. Virtualization can be seen in two ways: Server Virtualization and Software Virtualization.

3.1.1 Server Virtualization

It enables a single machine to run multiple application workloads where each workload is having independent environment and service level objective**.** Thus, workload performance can be drastically improved by directly integrating with key APIs to reduce resource hops. These technologies are capable of delivering various data center efficiencies at numerous levels. Resources in such environment can be managed from single point of control. We aim to work with server virtualization.

3.1.2 Storage Virtualization

It is a method to manage storage capacity from multiple vendors into a single reservoir of capacity by a single point. Increases the available disk space and optimizes the utilization rates. It also insulates changes occurring in host applications due to variations in physical storage systems.

Virtualization can definitely provide effective solution for green design of server and storage hardware as it consolidates many underutilized devices into more efficient and fewer equipment's that can led to energy saving. Virtualization Environment service delivery module is responsible for delivering application services over network. Our virtualization environment Data center Protection will deal with security and confidence related issues.

Virtualization Environment Service orchestration is for catalogue, asset account and source to sink plan. Virtualization Environment Energy Efficient Management includes power and cooling and data center physical construction component.

3.2 Integrating services with cloud computing

Cloud is a powerful tool to optimize data center as it is software defined technology and provides improved distributed infrastructure management. It can be achieved by migrating to cloud environment for selected functions like e-mail and other utilitarian functions to the clouds provided by third party. This will free infrastructure for focused application development. Organizations can also launch their own clouds to manage hardware architectures and to utilize converged data center approaches. Cloud offers other benefits in terms of fast deployment, pay for use policy, ubiquitous network access, greater resiliency and protection against network attacks. Security of such systems is an important aspect that includes real time detection of any tampering and fast re-constitution of service.

3.3 Optimized use of power through implementing Solar System

For effective performance, data centers require lots of energy causing a large amount of heat generation in servers. In this case we are going to implement solar panels to generate electrical power. Efficiency of such systems is measured in terms of Power Usage Efficiency (PUE). It is highly beneficial to use renewable energy resources to power up these centers. Data centers can also be located at places where plenty of such resources are available.Well maintained and well monitored data center can result in direct PUE optimizations,.E- waste minimization and developing thin client devices, these can contribute a lot in the process.

3.4 Environmental optimization by improved cooling system

Server generates large amount of heat and conventional systems of air-conditioning consumes much energy. New and effective methods can be implied to reduce this cost. One promising method can be a heat pipe based storage system. This is a location based cooling system to be deployed in low temperature geographical locations. This reduces the temperature and reduces the consumption of energy by data centers. Center will be located underground so it will require low storage space and construction cost.

Warm water from server can be pre-cooled to reduce the load of cooling in chiller reducing the power required for cooling in chiller. Other proposed schemes may be based on water cooling systems where water circulates around components with noticeably heater area.

4. Results and Discussion

The aim in this thesis is to make an ideal thought which can save our environment as well as also make profitable and eco-friendly business system. Our goal is energy optimization. Energy optimization of data centers requires various innovative methods and techniques in its implementation. In this paper Virtualization, cloud computing and energy efficiency methods have presented for reduction in carbon emission by providing more energy efficient data centers. These energy optimization techniques greatly impact the software architecture and hence security threat becomes a major issue. Various methods have been discussed in the area of virtualization and cloud computing to provide safety from intruders and hijackers.

However great amount of funding is still required to add Security of a Service in these existing system that can be eco-friendly and energy efficient with better performance because as mentioned above, the proposed approach tackles the problem by reducing the carbon footprint of data centers through the deployment of ICT technology and this technology require hardware and software which are expensive. Besides, there are various approaches of increasing the energy efficiency in data centers. Most of them are hardware oriented through investing in energy-efficient IT equipment or HVAC(heat, ventilation, air condition). Success in these areas, however, can only be incremental, as the capital cost of replacing old equipment is high. Therefore, the proposed solution is based on a different perspective: independently of the current IT and HVAC infrastructure, an energy-aware middleware is proposed that re-arranges the workload in a data center and among a federation of data centers according to the optimal energy and/or CO2 emissions efficiency. The middleware is designed agnostic of the existing data center automation and management frameworks and takes into account not only transferring workload to the most efficient clusters in a data center, but also re-allocating workload within a federation of data centers with the ultimate objective of reducing the global energy and/or CO2 emissions. It is worth pointing out that the devised plug-in is suitable for any computing style being traditional, supercomputing or cloud computing.

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