

GREEN DATA CENTRE OPTIMIZATION AND SECURITY ISSUES: A SURVEY PAPER

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Abstract— Information technology is growing at an exponential rate and has direct impact over the entire society. Data centers are the building blocks of IT business organizations. Most of the Internet traffic is concentrated on data centers as maximum computation and storage are moving into the cloud that provides the capabilities of centralized repository for storage, management, networking and dissemination of data. These data centers consume tremendous amount of energy. All data center are plagued with thousands of servers as major components. 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. This paper presents a systematic overview on paper Virtualization, cloud computing and energy efficiency methods as well as drop of carbon emission from data centers.

Index Terms— GREEN DATA, SECURITY ISSUES.

I. INTRODUCTION

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.

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. [1, 2]. 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.

II. GREEN COMPUTING

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 [3-5].

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 [4].

Effect of computing on environment can be summarized as:

Green use: It is a process to reduce energy consumption by computers and other ICT systems for environment friendly ways.

Green disposal: It is about refurbishing or reusing old computers.

Green design: To design environment friendly computers, servers, and components.

Green manufacturing: It refers to the production of electronic components, computers and other subsystems without impacting environment.

III. GREEN DATA CENTERS

Data centers provide centralized data access zone by housing large size of data and also usability of data. They also provide service such as :Hardware installation & maintenance, Managed power distribution, backup power systems, Data backup & archiving, managed load balancing, controlled Internet access, managed e-mail & messaging, server collocation & hosting, virtual servers, GRID & Cloud computing services, managed user authentication and authorization, firewalls, data security, etc.[6, 7] Data centers provide necessary physical environment that facilitates power backup, communication equipment, air-conditioning and physical security devices. Green data centers refers to such centers that can efficiently utilize maximum amount of energy with minimum impact on environment.[8] They are definitely an alternatives to reducing costs and saving energy in comparison to non-green data centers.

IV. OPTIMIZATION OF GREEN DATA CENTERS

Data centers consumes energy in critical computational systems such as servers, networks & storage, cooling systems, hosting other devices, conversion of power between alternating and Direct current including Power Distribution Units[9]. 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, implementation of components and virtualization. This section discusses various ways of optimization of datacenters:

A. 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:

- (a) 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.
- (b) Storage Virtualization: It is a method to manage storage capacity from multiple vendors into a single reservoir of capacity by a single point.
- (c) This is highly beneficial to reduce the number of required spindles. 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.

Virtualization Environment Data center Protection deals with security and confidence related issues.

Virtualization Environment Service orchestration is for catalogue, asset account and source to sink plan. [9]

Virtualization Environment Energy Efficient Management includes power and cooling and data center physical construction component. [10]

B. 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 [11].

C. Optimized use of power:

For effective performance, data centers require lots of energy causing a large amount of heat generation in servers. Efficiency of such systems is measured in terms of Power Usage Efficiency (PUE). [12] 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. [13]

D. 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.[14-16]

E. Management transparency:

Now days, much of data distribution and resource sharing of data centers is occurring over wire. So, it becomes important to understand the details of programs running on physical systems. Clear data management is critical for optimization of data centers as these management platforms take DCIM, automation, cloud control and other data services to enhanced level [17].

V. SECURITY ISSUES IN GREEN DATA CENTERS

Green data centers primarily works on three delivery models namely, software as a Service (SaaS), Platform as a Service (Paas), Infrastructure as a Service (IaaS). Many assessment tests are performed to validate the security of the data backup.

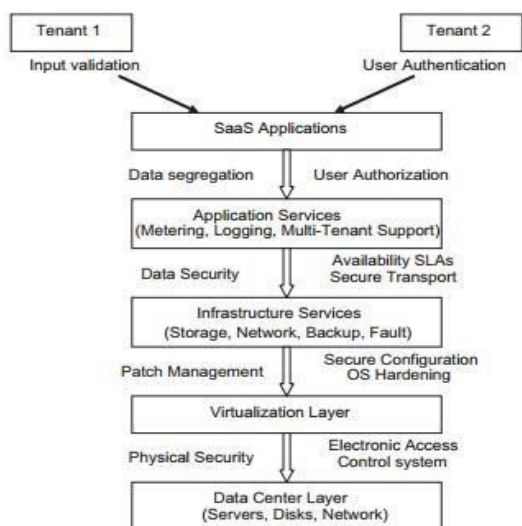


Fig 1. Security for a SaaS stack [11]

This test includes Identity management and sign-on process Identity management. This is a broad system that deals with the identity of individual in a system and controlling the access to resources by establishing identities. [11] Several other works and solutions have been proposed to improve the security of green data centers since conventional security measures such as firewall and IPS devices are not sufficient in provide stringent security desired by organizations. Traditional data centers security infrastructures caters to one problem at a time but more complex green computing data centers, it is required that all security components work together as one system. Security architecture must be proactive and applications must be able to cope with performance needs of such centers. "Enhanced security framework to ensure data security systems using cryptography" stressed on the importance on model security systems using symmetric and asymmetric cryptographic algorithms. Some security model is required while setting up of data centers in this scenario. These models are proposed in paper titled "Data Security Framework Rev 1.0" by Open data center alliance(ODCA). It described the following models; various levels of access control, proper classification of Information, data Encryption and digital certificates involving key management and availability to data encryption. Data masking is one of such technique that involves tokenization methods and data anonymization. Other areas to ensure security to systems being access control, Biometric access, Modular system design and Intelligent Video surveillance [18]. Siemens has worked on comprehensive and modular system that can effectively work with great reliability providing better time management and access control. This innovation has been named as SIPORT. It works on real time, thus, forbidding unauthorized people. Main features of SIPORT being Network available across the globe, extendibility, availability of various integration options, reliability and security with scalability. This innovation

provides solution to physical intruder attack and hack attack over a network [20].

CONCLUSION

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 work is still required to add Security of a Service in these existing system that can be ecofriendly and energy efficient with better performance indices.

Acknowledgement:

The authors are very grateful to respected Mr. Aseem Chauhan, Chairman, Amity University Lucknow, and Maj. Gen. K.K. Ohri, AVSM (Retd.), Pro-Vice Chancellor, Amity University, Lucknow Uttar Pradesh, India, for providing excellent research infrastructure facilities in the University campus. Authors also pay their best regards to Wg. Cdr. Dr. Anil Kumar Director Amity School of engineering & Technology, Amity University, Lucknow for giving their motivational support and help to carry out the present research work.

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