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Cloud Computing and its Environmental Effects

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Abstract

Cloud computing is providing basic level of computing facility to meet the daily needs of general or public community.in this paper we have selected the topic cloud computing and its environmental effects. Global warming, greenhouse effect, increasing temperature of the whole environment are major concerns regarding to rise in temperature and pollution of the environment of the whole world. No doubt cloud computing is providing basic facility of computing to general community but at the same time it is playing major role in increasing temperature of the whole world and becoming the source of pollution for the environment. In this paper different strategies have been adopted to control this problem. Virtualization technique is being utilized to control the problem of energy consumption and emission of carbon dioxide gas. So many techniques regarding to virtualization like live migration of VM, Dynamic Resource Allocation of different resources, virtualization of network resources like routers, routing protocols, virtualization of hardware resources like server, storage, memory and other devices. An effort is being exercised to reduce the problem of carbon emission and energy consumption of cloud computing to large extent.

Keywords: *Cloud Computing, Virtualization, Energy Consumption, Carbon Footprints, Environment Pollution.*

1. Introduction

With the invent of internet it was possible to shift data and services from one place to another place. Then due to massive computation in different fields like business, e-government projects, scientific research fields required more data, services and applications to complete their work. As the information and data become tremendously high enough then different techniques were required to handle such type of data like parallel computing, internet utility, distributed computing, grid based computing, utility computing and then cloud computing.

Cloud computing is an emerging field of computing rather it is becoming future computing field. Cloud computing is helpful in moving data, services and computing away from portable, mobile or desktop into larger cloud data environment or data center. When data or information and services are shifted toward cloud data center then cloud data centers become oversized. Such types of data centers become energy hungry data centers. Then such types of data centers will require more space, massive power, foolproof air-conditioning system, expert human resources also other infrastructures to meet the requirements. Main advantage of cloud computing are that users or consumers have not to pay for infrastructure, expert man power to handle such type of infrastructure and maintenance. Also there is no need of installation but there are some problems

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regarding to cloud data centers like high deployment and operational cost, security related issues, energy consumption, greenhouse gas emission carbon footprint, and pollution of environment. But in this paper we are only addressing the problem of energy consumption and environmental effect of cloud computing. Now the cloud data centers are becoming huge data centers. That will require huge amount of energy for operation which is becoming the main source of environmental pollution with the emission of greenhouse gas or CO2. The main source of environmental pollution are the diesel generators which are being used to generate power for grid stations which in turn are powering to data centers for operation.

To minimize the problem of energy consumption and carbon footprint there are many techniques which are being applied to handle this problem. In this regard virtualization technique is being used mostly to get the optimal solution of energy consumption and greenhouse gas emission problem. Virtualization technique is being used with different flavors for management of resources like live migration of VM, Dynamic Resource Allocation and similar other software techniques to counter the problem of energy consumption and carbon emission. Also different frames have been formulated just to calculate the energy consumption and carbon emission at different levels and for different resources which are also helpful to counter such types of problems. Some Energy Frames are also being used to control VM and switching off idle nodes when required. With the usage of such types techniques the problem of energy consumption and emission of carbon dioxide has been reduced to some extent. But still there is large space available for research just to reduce this problem considerably.

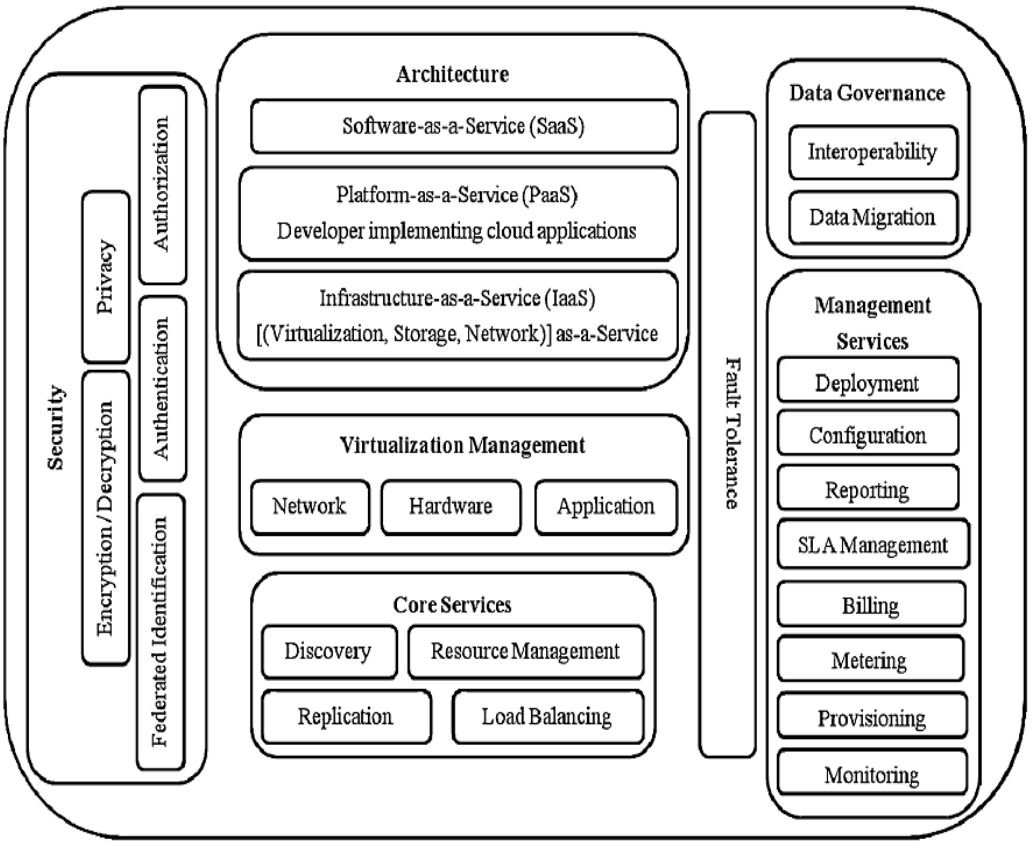

Figure 1. A Framework of Cloud Computing

2. Related Issues

The paper [1] shows the results about energy efficiency and low carbon emission apply specific methods on one type of cloud computing i.e. virtual private cloud. It is being considered that migration of VM efficiency in LAN and WAN environments is the prominent solution for gaining server consolidation.

In the current work intelligently VM live migration in WAN is being used as a tool of reallocation just to minimize the carbon footprint overall for the specified network. Also some methods are being provided for the calculation of carbon print and consumption of energy for the specified network which may be used to test the services for customer in case of cleaner energy cloud services. Genetic algorithm (GA) based method is being used for the live migration of WM which can reduce significantly emission of carbon in LAN enforcement. Also when the results of energy optimization & carbon emission were calculated against VPC data centers then the results were different or not optimum in case of VPC.

This Paper [2] is an analysis about energy consumption in cloud computing environment. Paper analysis consider the two types of cloud computing i.e. public and private clouds & energy consumptions are taken in the form of switching, transmission, data processing & data storage. Results of analysis showed that energy consumption for switching and transportation contribute the significant percentage of total energy consumption in case of cloud computing environment observing the results of analysis it is concluded that cloud computing is not greenest computing technology. In the present work [3] of paper the concept of Green cloud Framework is being present for the improvement of system efficiency in cloud data center. The proposed framework is being used to for VM control saving the overall power of the whole system. For controlling VM a power based scheduling algorithm is being used for the optimum utilization of VM with minimum power consumption, also management of VM s being performed with the help of VM designing, emigration. & dynamic shutdown according to requirement, with the use of specified model energy can be saved to maximum extent, also the operational cost of cloud computing can be reduced to large extent. In this paper [4]of cloud computing specified policy is being described to minimize power consumption & reducing the carbon foot print factor. According to given policy an algorithm is used for reallocation of VM is performed leveraging migration & switching off idle nodes in cloud data center, while performing this task the QOS is not compromised results indicate that dynamic reallocation of VM in the setup becoming the cause of energy saving to large extent. Hence playing important role reducing energy consumption & carbon footprint. In this paper [5] problem of energy consumption, maximum utilization of data center resources, Minimization energy consumption & carbon footprint are being addressed for searching proper solution. To achieve the specified results they are using methodology for the dynamic allocation of VM and switching idle nodes according to requirement. Technique for dynamic allocation of VM is used base on adoptive utilization of threshold which fulfills the requirements of serve level agreements to large extent. In [6] paper it is stressed & focused how to convert cloud computing into green cloud computing. For this purpose they are giving some proposals about architectural principles of cloud data centers w.r.t. energy efficient management. Policies & scheduling for resource allocation energy-efficient way of cloud computing also the novel software technique for energy efficient cloud computing management. By adapting such proposed methods energy consumption of cloud computing environment can be reduced to large extent and also envision of CO2 can be reduced t large extent which is the requirement of green computing.

In this [7] paper problems regarding to green computing are highlighted & their solution is also being provided. The problems highlighted in papers are impact of data centers to electric grid, greenhouse Gase emissing and carbon foot print. In this regard the

location of data centers & routing of services are studied with respect to cost and QoS taking into consideration after experimental results of different scenarios they proposed an optimization framework for location of data centers & routing protocols for service provision for different located users. By adopting the specified framework problems like carbon emission & energy consumption can be reduced to large extent. In this paper [8] some measures are performed to convert cloud computing into green cloud computing. In this regard they are offering architectural principles for cloud date center, resource allocation policies and scheduling algorithm and open research challenges, considering QOS and power consumption algorithms regarding and resource allocation of dynamic consolidation for VM give good results as compare to techniques using static resource allocation cloud middle ware and associated methods are being used to reduce the cost of software engineering. Third party and services are also being used to achieve good results in the for VM technology like open source Xen and KVM also commercial products of VM ware like EC2 S3. Also they are using their own technology like Aneka. For building enterprise clouds Generic source manager and plugin – adopters are being used for interaction of different system for cloud management likes Aneka and Amazon EC2. By adapting such methodologies whole system gives good results in the form of reduced emission of CO2 and reduces energy consumption. The paper [9] is about the subject that how to use the resources of data center maximal & how to reduce energy consumption &carbon emission in the whole system. For this purpose they have introduced a decentralized architecture management system for energy aware resources. For experimental purpose they have used Aneka as a platform. Dynamic consolidation for VM gives good results in case of energy saving while giving required QoS. By adopting this method operational cost reduces, energy saves and carbon footprint reduces to large extend which are the requirements of consumers and environment. In the paper [10] for energy saving Live migration of VM methodology s being used also it is useful for load balancing in cloud data centers. Paper focus on live Migration strategies for VM with different resource reservation methods. They measure performance of the system using different live migration strategy with different resource reservation methods. Performing different experts using different parameters of live migration of VM they conclude that live migration of VM technology is an efficient technology for saving energy & load balancing. In the paper [11] energy saving and low carbon emission an energy manager in form of Energy Farm has been introduced for future cloud or grid data center infrastructure. Energy Farm using matching algorithm for service demand and capabilities of job aggregation makes the idle servers turn off while considering both the requirements of demand also physical & logical dependencies, experimental results indicate that using Energy farm in cloud data center infrastructure high efficiency in case of resource utilization can be achieved. By using Energy farm. It is also possible to save energy in MW reducing the emission of CO2 in tons also low costs can be achieved using the proposed Energy Farm.

In the paper [12] importance of green management is being highlighted which is helpful to reduce the environmental pollution. Environmental pollution, global warming, destruction of ecological resource and climate change are badly effecting the human life, style, quality and health. These things are threatening the human life standards. In the current paper 6R Principle is being introduced to reduce the above mentioned factors which are being alarming condition for human life. The 6 R principle include, research reduce, reuse, recycle, rescue and revive, which should be adopted to save energy & reduce carbon emission in IT section could computing is becoming the fast growing IT field now a days. In cloud computing some measures should be taken to reduce carbon emission and saving energy for environment. In paper [13] a framework is being presented for VM placement in cloud data centers considering energy efficiency for operation. Proposed frame work is energy aware and flexible frame work for allocation and reallocation of VMs in cloud data centers. Frame work is totally independent from

management of cloud data centers. Best placement of VM is done through constraints, which are expressed in service level arrangements to fulfill this requirement constraint programming (CP) paradigm is adopted using cluster management library called Entropy. Simulation results showed the optimization goal in case of energy saving and reducing emission of carbon. Core element of frame is optimizer which has the capability to deal with SCA requirements & federation of different data centers. CP and entropy (open source library) are used to compute placement of VM regarding to energy-aware.

In the paper [14] to get the required results , Green power management (GPM) is being used with Dynamic Resource Allocation (DRA) for load balancing with VM management & energy saving for the whole system by using this setup they have proved that energy can be saved significantly as compared to traditional approach. In order to achieve the required results for energy saving & emission of CO_2 the proposed work is presenting energy consumption model for cloud data center environment and also presenting the analysis tool relating to energy consumption model [15], When this model is applied for different sciences and after the analysis of energy consumption in different environments for storage, computation, powering the calculation may be helpful to control energy consumption for the whole environment by using this mode energy can be saved to large extent [15].

Table 1: Explains the Technologies and Algorithms of the Selected Studies

Year	Author name	Method or technology	algorithm
2011	Fereydoun Farrahi Moghaddam, Mohamed Cheriet, Kim Khoa Nguyen	virtualization	Genetic Algorithm
2010	ByJayant Baliga, Robert W. A. Ayre, Kerry Hinton, and Rodney S. Tucker	calculation of switching and transportation energy for different resources	
2010	Andrew J. Younge, Gregor von Laszewski, Lizhe Wang, Sonia Lopez-Alarcon, Warren Carithers	Virtualization, Green cloud Framework	
2010	Anton Beloglazov and Rajkumar Buyya	virtualization , allocation and Reallocation of VM	Best Fit Decreasing (BFD) and modified best Fit Decreasing (MBFD)
2010	Anton Beloglazov and Rajkumar Buyya	virtualization, Dynamic allocation of VM based on adaptive utilization threshold	Dynamic Threshold(DT) Modified Best Fit Decreasing (MBFD)
2010	Rajkumar Buyya , Anton Beloglazov, Jemal Abawajy	virtualization , Architectural principals of cloud data centres	
2010	Amir-Hamed Mohsenian-Rad , Alberto Leon-Garcia	Proper location of data centers and proper using of routing protocols for service provision	
2011	Fereydoun Farrahi Moghaddam, Mohamed Cheriet, Kim Khoa Nguyen	virtualization ,Xen and KVM for VM, Aneka platform, Dynamically Resource Allocation	Minimization for Migration MM
2010	Anton Beloglazov, Jemal Abawajy, Rajkumar Buyya	virtualization ,Decentralized architecture for management of resources dynamic consolidation of VM	
2011	Sergio Ricciardi,Davide Careglio, Ugo Fiore Centro Servizi Informativi , Francesco Palmieri Dipartimento di Ingegneria	Live migration of VM	
2011	Sergio Ricciardi,Davide Careglio, Ugo Fiore Centro Servizi Informativi , Francesco Palmieri Dipartimento di Ingegneria	Saving energy with the use of EnergyFarm	Service demand matching algorithm
2012	Dung-Hai Liang, Dong-Shong Liang, Chun-Pin Chang		
2012	Corentin Dupont, Giovanni Giuliani, Fabien Hermenier	Virtualization, Placement of VM using Frame work of specified features	
2011	Chao-Tung Yang, Kuan-Chieh Wang, Hsiang-Yao Cheng, Cheng-Ta Kuo, William Cheng C. Chu	Green Power Management (GPM) with Dynamic Resource allocation (DRA) for load balancing & energy saving	

2012	FeiFei Chen, Jean-Guy Schneider, Yun Yang, John Grundy, and Qiang He	Energy consumption model & analysis tool	

3. Conclusion

In the paper some problems like energy consumption, emission of greenhouse gas; carbon footprints have been addressed and try to reduce these problems to some extent using different software techniques. Among the other techniques virtualization is an important technique which is playing major role to reduce the problem of environmental effect of cloud computing. Virtualization in different flavors is being implemented to reduce the above mention problem. Besides these solutions in the form of software techniques which are being used to reduce the problem of environmental effect of cloud computing there may be other solutions to counter this problem. The diesel generators which are powering the grid stations are the main source of generating CO_2 which in turn providing electricity to cloud data centers. With the passage of time data and information are increasing tremendously and this information is rushing toward data center of cloud computing environment. Due to high flux of different types of data the size of data centers is becoming unaffordable and unmanageable due to huge size of data, high electricity bills, and management of resources and devices.
Another solution of the problem is that it should be launched a survey for the establishment of new data centers where the problems of environmental pollution and electricity billing should be minimum. For this purpose we should select such sites or geographical locations where electricity cost is minimum and mostly polluted free. Locations should be selected in such a way that support wind energy, hydro power or solar energy. The electricity produced by these resources would be low cost and free of environmental pollution.

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