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Green Cloud Computing using Artificial Neural Networks

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Abstract— This paper presents the results of simulation work performed to enhance the effectiveness of Green Cloud Computing using Artificial Neural Networks. It has been shown that to predict that whether the cloud architecture will be green or not can be made more accurate by employing Artificial Neural Networks. The advantage of this work is that it eliminates the need to invest on the costly hardware to conduct experiments to predict whether the cloud computing architecture will be green or not. By simulation work both time and expenditure can be reduced.

Keywords— Green, Cloud,, Computing Artificial, Neural, Networks

I. INTRODUCTION

Cloud computing is emerging as a paradigm for large-scale data-intensive applications. Cloud Computing is composed of amalgamation of different elements and solutions, namely operating systems running on a single virtualized computing environment, middleware layers that attempt to combine physical and virtualized resources from multiple operating systems, and specialized application engines that influence a substantial benefit of the cloud service provider. The importance of Cloud Computing cannot be overemphasised. Cloud computing is emerging as an important technology for scientific and business applications. Information and communication technology profoundly impacts on environment because of its contribution to carbon footprint. The research field of green and low power consumption networking infrastructures is of great importance for both service and manufacturing industry. This emerging technology can increase the utilization and efficiency of hardware and software. It can reduce the carbon footprint. A virtual network architecture for cloud computing can reduce the carbon footprint. It can provide communication functions for virtual resources in cloud computing [1].

With energy shortages and global climate change leading Green Cloud Computing is becoming an important issue. Obviously, a substantial reduction in energy consumption can be made by shutting down hardware when it is not in use. Neural network predictor can be used for optimizing hardware power consumption in Cloud computing. The predictor can be employed to predict future load demand based on historical demand. According to the prediction, the algorithm turns off unused hardware and restarts it to minimize the number of running servers, thus minimizing the energy use at the points of consumption to benefit all other levels [2].

Cloud computing is rapidly expanding as an alternative to conventional desktop computing. As cloud computing becomes more widespread, the energy consumption of the network and computing resources of the cloud will grow. This is happening at a time when there is increasing attention being paid to the need to manage energy consumption across the entire information and communications technology sector. Energy consumption in transport and switching can be a significant percentage of total energy consumption in cloud computing. Cloud computing can enable more energy-efficient use of computing power, especially when the computing tasks are of low intensity or infrequent. However, under some circumstances cloud computing can consume more energy than conventional computing where each user performs all computing on own personal computer [3]. Information Technology is essential for every successful modern business. It is so pervasive, that energy efficiency through the implementation of green Information Technology has become important for many companies in their need of helping make a difference for the environment. Green Information Technology is an ideal way for most companies to make a significant step in the green direction [4].

Financial services organisations require a phased, systematic, people-oriented, business-focused and low risk approach that combines both business and technology impacts to the assessment, selection, consolidation and adoption of these technologies for specific business services without putting their customers' information at risk [5]. The problem of resource allocation in a large-scale cloud environment can be addressed by dynamically optimizing a cloud configuration for green computing objectives under CPU and memory constraints. Power consumption can be minimized through server consolidation, while satisfying a changing load pattern [6]. The Internet has provided an unlimited potential with access to e-books, multimedia content, news, new ideas, and information access in general. Nothing works without the

electric and network infrastructure in place. The sad fact is diesel generators are used to power everything in place of a stable power grid. Most of developing countries have tremendous amount of wind or solar energy that can be used in place of imported fossil fuels. The developing regions in most cases are connected to the Internet. There is a need to interconnect inside the regions and countries and move the data closer to the end user [7].

II. LITERATURE SURVEY

The greatest environmental challenge today is global warming which is caused by carbon emissions. In order to reduce this problem, the cloud computing solution must regulate the internal settings to address the pressing issue of data centre over-provisioning related to the need to match the peak demand. In this context an integrated solution for resource management based on organization models of autonomous agent components is required [8]. Increased demand of cloud computing has caused more load on data centres consuming more energy and therefore there is more CO2 emission. Using resources more efficiently can help reducing energy consumption in data centres. There are different hardware and software solutions and technologies such as virtualization, using hardware with lower energy consumption, and implementing efficient software algorithms to optimize energy consumption. An energy-aware layer in software architecture that is responsible for evaluating micro-metrics and macro-metrics of energy consumption in data centres can be used to make the services to migrate to hosts consuming energy more efficiently [9]. Green Cloud Computing points to a processing infrastructure that combines flexibility, service quality , and reduced use of energy . Energy crisis fuels green computing , and green computing needs algorithms and mechanisms to be redesigned for energy efficiency . There is a need to use computing resources efficiently, effectively and economically. The various approaches to green information technology are virtualisation, power management, Materials Recycling and Telecommuting. It is necessary to significantly reduce pollution and substantially lower power consumption . Analysis of energy consumption in cloud with green algorithm may allow more efficient use of the energy [10]. Green cloud computing is a broad range and a hot field. Cloud computing is offering utility oriented IT services to users worldwide. Data centre hosting cloud computing applications consume huge amounts of energy, thereby contributing to high operational costs and carbon footprints to the environment. With energy shortages and global climate, the power consumption of data centres has become a key issue. Thus, there is a need of green cloud computing solutions that cannot only save energy, but also reduce operational costs. The vision for energy efficient management of cloud computing environments is the need of the hour. A green scheduling algorithm which works by powering down servers when they are not can be effective [11].

The arbitrary use of cloud computing, whether private or public, can lead to wasteful energy consumption in data processing , storage and communications . Therefore, the green cloud computing solutions aim to not only save energy but also reduce operating costs and carbon footprint on the environment . A Green Cloud Integrated Architecture that is composed of a Green Cloud customer oriented Middleware can be used to help managers to better monitoring and configuration of general access to cloud services in the most efficient way to green energy[12]. The distinction between the consumer of and the provider of cloud-based energy resources may very important in creating a world-wide ecosystem of Green Cloud Computing . A user simply submits its service request to the cloud service provider with the connection of Internet or wired/wireless networks. The result of the requested service is delivered back to the user in time, whereas the information storage and process, interoperating protocols, service composition, communications and distributed computing, are all smoothly interactive by the networks. There is a need to make Cloud computing green. This means provisioning cloud service while considering energy consumption under a set of energy consumption criteria and it is called Green Cloud Computing . Work has been done in Green Cloud Computing based on networks, including microprocessors, task scheduling algorithms, virtualisation technology, cooling systems, networks and disk storage [13].

Global warming, climate change, damage of ecological resources, and environmental pollution have seriously influenced and threatened human life quality as well as health. Therefore, it is very important for all business and industry to fully carry out the 6R principles including research, reduce, reuse, recycle, rescue, and revive and then the warming condition can become better. In order to control the principles of green management 6R, we research, reduce, reuse, recycle, rescue and revive contains regenerate, refresh or recovery for administrative organization and administrative environment. Cloud computing has been regarded as the most potential solution of information technology. It not only reduces the consumption of paper but advances the IT level too. Based on these advantages, cloud computing has stridden into green management industry with energy-saving and high efficiency from the booming IT field [14]. Cloud computing, the next generation computing system, is gradually being got more and more attention on its green energy-saving characteristics in academia. Strategies of green energy saving for cloud computing platform can be based on hardware design, software technology, virtual machine manager and network environment using fuzzy logic techniques [15]. Cloud computing is a business oriented concept to provide online IT resources and IT services on demand using pay per use model where main goal of cloud service provider is to use cloud computing resources efficiently and gain profits marginally. One of the challenging areas in cloud computing is frequent optimization of cloud

server. It mainly concerns with the load balancing of cloud data centres to improve efficiency of the host machine and minimize number of active host machine to support green computing concept. To balance the load of entire data centre, it is required to transfer the virtual machines of the overloaded host to the light weighted host using migration techniques [16]. In this platform, huge amount of resources are present in the cloud and this resources need to be managed effectively.

When this resources are united, major problems are incorporated into the system as well as the application due to compatibility and consistency constraints, hence there does not exist a unified processing environment to carry out this operation. There is a need of cloud OS known as virtual distributed operating system that binds together this cloud resources in a single-unified processing environment that helps to manage the cloud resources in a flexible and accessible approach henceforth enhancing the systems performance. Several cloud OS are available to bridge the gap between this cloud resources. By making use of a cloud OS the overhead in handling the cloud resources by the running machine can be successfully reduced for a particular cloud user hence directing towards efficient use of systems resources and contributing towards the features of green computing [17].

Demand for clean products and services is increasing as society is becoming increasingly aware of climate change. In response, many enterprises are setting explicit sustainability goals and implementing initiatives to reduce carbon emissions. Quantification and disclosure of such goals and initiatives have become important marketing tools. As enterprises and individuals shift their workloads to the cloud, this drive toward quantification and disclosure will lead to demand for quantifiable green cloud services. The cloud providers should offer a new class of green services, in addition to existing (energy-source-oblivious) services. This new class would provide clients with explicit service-level agreements (SLAs) for the percentage of renewable energy used to run their workloads. Specifically, each client job specifies a Green SLA, which is the minimum percentage of green energy that must be used to run the job. The provider earns a premium for meeting the Green SLA, but is penalized if it accepts the job but violates the Green SLA. A Green SLA service would enable the provider to attract environmentally conscious clients, especially those who require strict guarantees on their use of green energy [18]. Due to limited energy, environmental problems and the fast growth of computer power consumption, the design, study and management of a Green Cloud Computing system are increasingly difficult and expensive as existing configurations are multiple and complex. Several approaches exist for modelling and simulating Green Cloud Computing . Current software environments try to take into account as many phenomena and facilities as possible according to a planning level (strategic, tactical or operational) [19].

As cloud computing becomes more emerging technology, there is increasing attention being paid to the energy consumption pattern across the entire information and communication technology (ICT) sector. With advent of cloud computing, computing functions and storage processing are migrating to remote resources like virtual servers stored in systems which are mostly hosted in the data centres located in various places. Virtualization technology has been used widely in modern data centre in order to improve its energy efficiency. Virtual machine (VM) migration has recently emerged technique used as an essential building block for data centre and storage systems, mainly due to its service provisioning and energy aware consolidation [20]. The increasing industrial acceptance of cloud-based IT services has led to a paradigm shift in the development and operation of complex business applications. Moving towards Cloud Computing, high performance computing usage of huge data centre and huge cluster is increasing day by day and energy consumption by these DC and energy dissipation in environment by these DC is also rising day by day. The large amount of CO2 dissipation in environment has generated the necessity of Green computing. More processor chips generates more heat, more heat requires more cooling and cooling again generates heats and thus we come to a stage where we want to balance the system by getting the same computing speed at decreased energy consumption [21].

Cloud computing's recent proliferation has received attention from green crusaders hoping to mitigate the carbon footprint of large datacentres and IT infrastructures and energy-efficient software development [22]. Cloud infrastructures allow users to remotely access to computing power and data over the Internet. Beside the huge economical impact, data centres consume enormous amount of electrical energy, contributing to high operational cost and carbon footprints to the environment. An advanced resource allocation model is therefore needed to not only reduce the energy consumption of data centres but also provide incentives to users to optimize their resource utilization and decrease the amount of energy consumed for executing their application. The green greedy algorithm can significantly reduce the amount of consumed energy while generating higher revenue for cloud providers [23]. Cloud Computing is an emerging technology and is being used by more and more IT companies due to its cost saving benefits and ease of use for users. But, it needs to be environment friendly also. Therefore, Green Cloud Computing is the requirement of the today's world. Cloud Computing can be made more energy efficient and reduce the carbon footprint rate by various approaches of virtualization and various approaches which use virtual machines scheduling and migration to can help to make the system more energy efficient [24]. Cloud-based IT services are being used as replacements and/or as enhancements for existing on-site solutions. This strategy leads to the concept of a federated business application, which consists of a variety of on-site and cloud-based subparts, dynamically orchestrated to a single solution. The selection of appropriate IT services is critical for cloud computing. Following the discussions of environmental thinking in IT aspects like Green Information Technology and Green IS, the issue of appropriate IT service depends on not only functionality and costs, but additionally also on the environmental impact of the service selection [25].

III. SIMULATION DETAILS

Graphs below show the results of the ANN based prediction system for Energy Optimization using different parameters of the cloud architecture. It was found that using ANN the accuracy of the Green Cloud computing network was found to be 90% of the time to be energy efficient. Fig 1 below shows the neural network training progress.

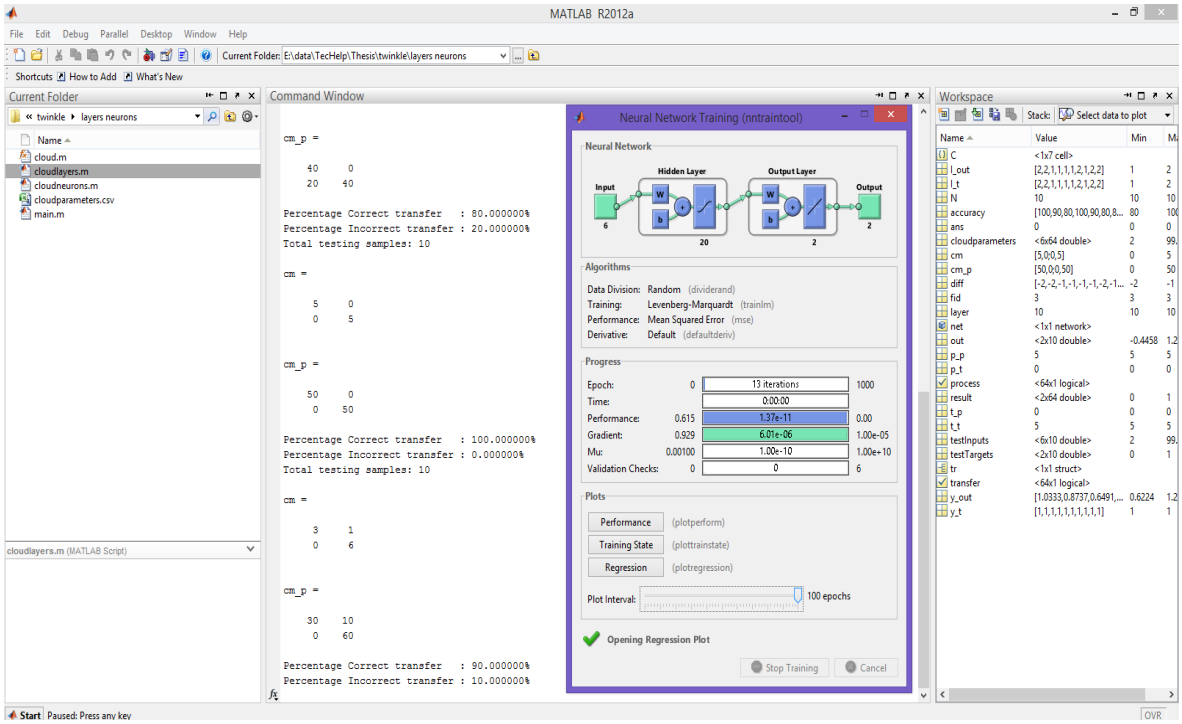

Fig 1

Fig 2 below gives the performance of the network. When the training in Train and Apply Multilayer Neural Networks is complete, the network performance can be checked to determine if any changes need to be made to the training process, the network architecture, or the data sets.

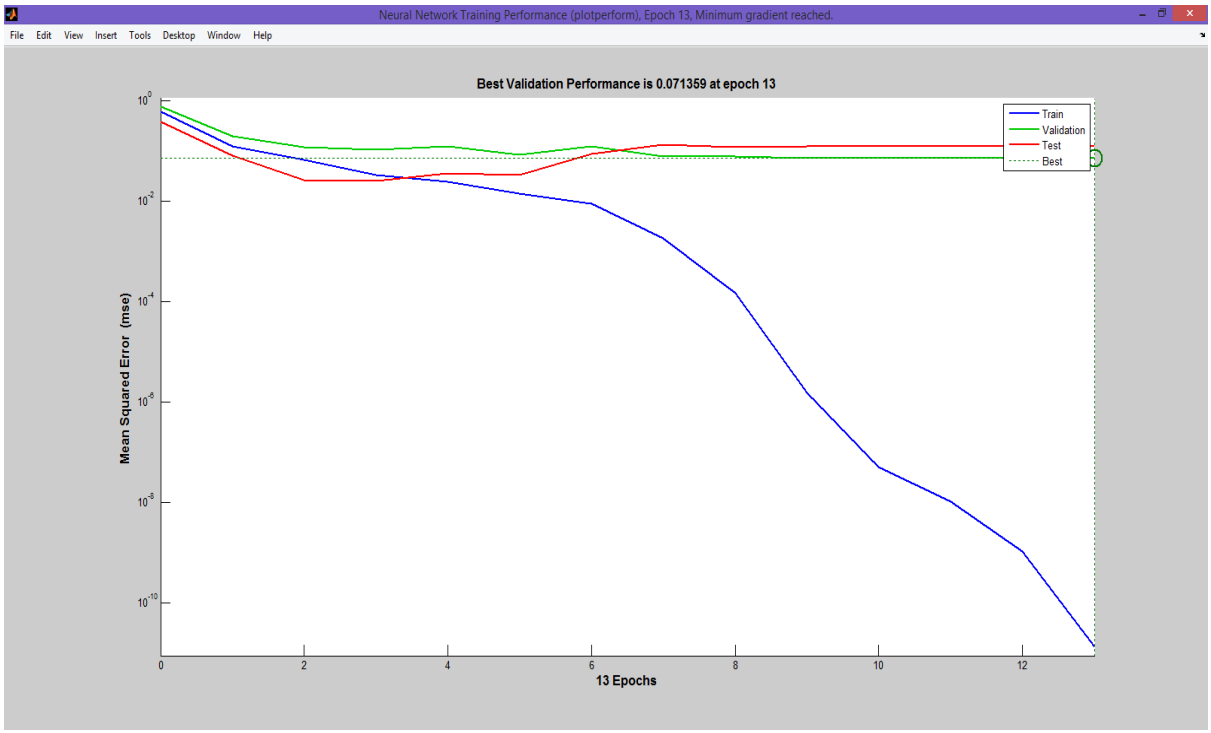

Fig 2

Fig 3 below shows the training state of the network. It contains all of the information concerning the training of the network. For example, the indices of the data points that were used in the training, validation and test sets, respectively.

The structure also keeps track of several variables during the course of training, such as the value of the performance function, the magnitude of the gradient, etc.

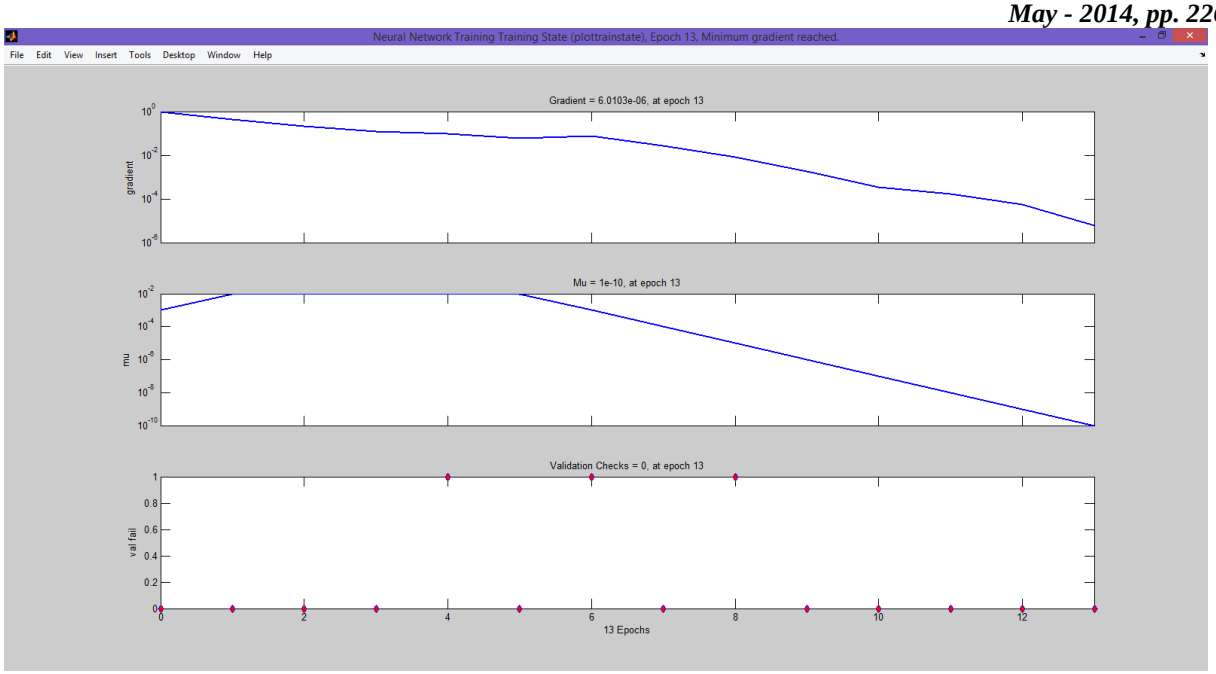

Fig 3

This figure does not indicate any major problems with the training. The validation and test curves are very similar. If the test curve had increased significantly before the validation curve increased, then it is possible that some over fitting might have occurred.

The next step in validating the network is to create a regression plot, which shows the relationship between the outputs of the network and the targets. If the training were perfect, the network outputs and the targets would be exactly equal, but the relationship is rarely perfect in practice. Fig 4 below shows the regression analysis using three regression plots for training, testing and validation.

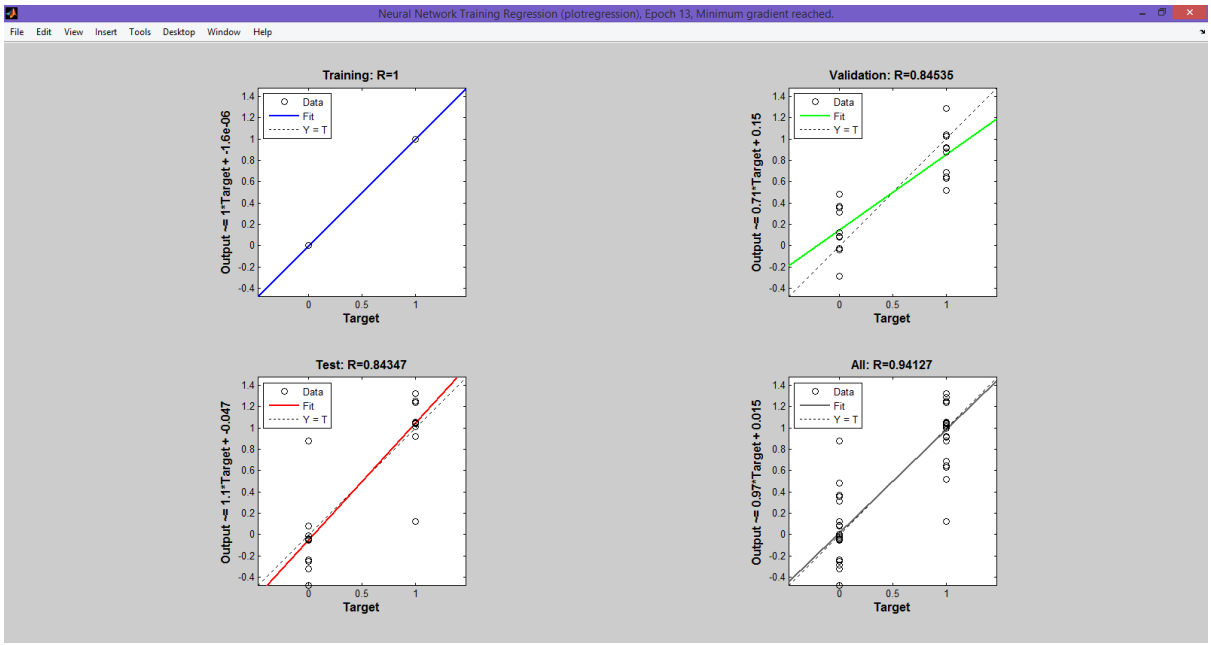

Fig 4

The three plots represent the training, validation, and testing data. The dashed line in each plot represents the perfect result – outputs = targets. The solid line represents the best fit linear regression line between outputs and targets. The R value is an indication of the relationship between the outputs and targets. If R = 1, this indicates that there is an exact linear relationship between outputs and targets. If R is close to zero, then there is no linear relationship between outputs and targets. The training data indicates a good fit.

IV. CONCLUSIONS

It has been found that to predict that whether the cloud architecture will be green or not can be made more accurate by employing artificial neural networks. As shown in the case above the accuracy prediction was 90%. The advantage of this work is that it eliminates the need to invest on the costly hardware to conduct experiments to predict whether the cloud computing architecture will be green or not. By simulation work both time and expenditure can be reduced.

REFERENCES

[1] Ruay-Shiung Chang; Chia-Ming Wu, "Green virtual networks for cloud computing," Communications and Networking in China (CHINACOM), 2010 5th International ICST Conference on , vol., no., pp.1,7, 25-27 Aug. 2010

[2] Truong Vinh Truong Duy; Sato, Y.; Inoguchi, Y., "Performance evaluation of a Green Scheduling Algorithm for energy savings in Cloud computing," Parallel & Distributed Processing, Workshops and Phd Forum (IPDPSW), 2010 IEEE International Symposium on , vol., no., pp.1,8, 19-23 April 2010

[3] Baliga, J.; Ayre, R.W.A.; Hinton, K.; Tucker, RodneyS., "Green Cloud Computing: Balancing Energy in Processing, Storage, and Transport," Proceedings of the IEEE , vol.99, no.1, pp.149,167, Jan. 2011

[4] Lamb, J., "Green Information Technologyand use of private cloud computing in South Africa," Emerging Technologies for a Smarter World (CEWIT), 2011 8th International Conference & Expo on , vol., no., pp.1,6, 2-3 Nov. 2011

[5] Gill, A.Q.; Bunker, D.; Seltsikas, P., "An Empirical Analysis of Cloud, Mobile, Social and Green Computing: Financial Services IT Strategy and Enterprise Architecture," Dependable, Autonomic and Secure Computing (DASC), 2011 IEEE Ninth International Conference on , vol., no., pp.697,704, 12-14 Dec. 2011

[6] Yanggratoke, R.; Wuhib, F.; Stadler, R., "Gossip-based resource allocation for green computing in large clouds," Network and Service Management (CNSM), 2011 7th International Conference on , vol., no., pp.1,9, 24-28 Oct. 2011

[7] Baikie, B.; Hosman, L., "Green cloud computing in developing regions Moving data and processing closer to the end user," Telecom World (ITU WT), 2011 Technical Symposium at ITU , vol., no., pp.24,28, 24-27 Oct. 2011

[8] Werner, J.; Geronimo, G.; Westphall, C.; Koch, F.; Freitas, R., "Simulator improvements to validate the Green Cloud Computing approach," Network Operations and Management Symposium (LANOMS), 2011 7th Latin American , vol., no., pp.1,8, 10-11 Oct. 2011

[9] Beik, R., "Green Cloud Computing: An Energy-Aware Layer in Software Architecture," Engineering and Technology (S-CET), 2012 Spring Congress on , vol., no., pp.1,4, 27-30 May 2012

[10] Yamini, R., "Power management in cloud computing using green algorithm," Advances in Engineering, Science and Management (ICAESM), 2012 International Conference on , vol., no., pp.128,133, 30-31 March 2012

[11] Gayathri, B., "Green cloud computing," Sustainable Energy and Intelligent Systems (SEISCON 2012), IET Chennai 3rd International on , vol., no., pp.1,5, 27-29 Dec. 2012

[12] Hulkury, M.N.; Doomun, M.R., "Integrated Green Cloud Computing Architecture," Advanced Computer Science Applications and Technologies (ACSAT), 2012 International Conference on , vol., no., pp.269,274, 26-28 Nov. 2012

[13] Xiong, N.; Han, W.; Vandenberg, A., "Green cloud computing schemes based on networks: a survey," Communications, IET , vol.6, no.18, pp.3294,3300, Dec. 18 2012

[14] Dung-Hai Liang; Dong-Shong Liang; Chun-Pin Chang, "Cloud Computing and Green Management," Intelligent System Design and Engineering Application (ISDEA), 2012 Second International Conference on , vol., no., pp.639,642, 6-7 Jan. 2012

[15] Lin Gong; Jian Xie; Xiaolan Li; Bo Deng, "Study on energy saving strategy and evaluation method of green cloud computing system," Industrial Electronics and Applications (ICIEA), 2013 8th IEEE Conference on , vol., no., pp.483,488, 19-21 June 2013

[16] Sahu, Y.; Pateriya, R.K.; Gupta, R.K., "Cloud Server Optimization with Load Balancing and Green Computing Techniques Using Dynamic Compare and Balance Algorithm," Computational Intelligence and Communication Networks (CICN), 2013 5th International Conference on , vol., no., pp.527,531, 27-29 Sept. 2013

[17] Naik, N.N.; Kanagala, K.; Veigas, J.P., "Achieving green computing by effective utilization of cloud resources using a cloud OS," Emerging Trends in Computing, Communication and Nanotechnology (ICE-CCN), 2013 International Conference on , vol., no., pp.687,690, 25-26 March 2013

[18] Haque, M.E.; Kien Le; Goiri, I.; Bianchini, R.; Nguyen, T.D., "Providing green SLAs in High Performance Computing clouds," Green Computing Conference (IGREEN CLOUD COMPUTING), 2013 International , vol., no., pp.1,11, 27-29 June 2013

[19] Huet, J.-C.; El Abbassi, I., "Green Cloud Computing Modelling Methodology," Utility and Cloud Computing (UCC), 2013 IEEE/ACM 6th International Conference on , vol., no., pp.339,344, 9-12 Dec. 2013

[20] Arthi, T.; Hamead, H.S., "Energy aware cloud service provisioning approach for green computing environment," Energy Efficient Technologies for Sustainability (ICEETS), 2013 International Conference on , vol., no., pp.139,144, 10-12 April 2013

[21] Jain, A.; Mishra, M.; Peddoju, S.K.; Jain, N., "Energy efficient computing- Green cloud computing," Energy Efficient Technologies for Sustainability (ICEETS), 2013 International Conference on , vol., no., pp.978,982, 10-12 April 2013

[22] Chauhan, N.S.; Saxena, A., "A Green Software Development Life Cycle for Cloud Computing," IT Professional , vol.15, no.1, pp.28,34, Jan.-Feb. 2013

[23] Tram Truong Huu; Chen-Khong Tham, "An Auction-Based Resource Allocation Model for Green Cloud Computing," Cloud Engineering (IC2E), 2013 IEEE International Conference on , vol., no., pp.269,278, 25-27 March 2013

[24] Wadhwa, B.; Verma, A., "Energy saving approaches for Green Cloud Computing: A review," Engineering and Computational Sciences (RAECS), 2014 Recent Advances in , vol., no., pp.1,6, 6-8 March 2014

[25] Schrödl, H.; Simkin, P., "Greening the Service Selection in Cloud Computing: The Case of Federated ERP Solutions," System Sciences (HICSS), 2014 47th Hawaii International Conference on , vol., no., pp.4200,4209, 6-9 Jan. 2014.

