International Journal of Scientific & Technical Development
(A Peer-Reviewed Bi-Annual Journal) ISSN: 2348-4047

REVIEW ON ENERGY EFFICIENT RESOURCES UTILIZATIONS IN CLOUD INFRASTRUCTURE

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Abstract
In cloud computing, energy has been a major concern. This study does an evaluation of energy-efficient allocation of resources in the cloud. Because cloud allocation of resources is an NP-hard issue, several approximations have been proposed. Approximate solutions are also useful in resource allocation; therefore such solutions can be helpful for future work. This paper focuses on efficient energy-aware cloud (EEAC) computing approaches for system and device recognition and classification, optimization approaches, and energy / power control techniques. Network, clusters, and clouds are examples of system types, while processing units, and hybrid systems are examples of device kinds. The goal includes calculations such as execution time and energy usage, all while keeping power and energy consumption to a minimum. Scheduling controls, frequency-based policies (DVFS, DFS), application standardization, and hybrid approaches are common control measures. We investigate energy/power management solution and APIs, as well as methodologies and scenarios for forecasting or modeling power/energy use in current EEAC systems.
Keywords: Cloud computing, energy efficient, power consumption, energy usage, energy aware cloud.

1.Introduction

Cloud computing necessitates resource management systems that are energy efficient (i.e. switches, servers and virtual machines). A choice of methodologies for achieving sustainable energy efficiency in cloud technology has been anticipated in the literature. Cloud technology, but in the other extreme, is often regarded as the most promising technology for addressing the energy crisis [1]. This is corroborated by multiple studies, including one [2] that claims that moving to the cloud will save energy consumption by 87 percent. Efficient energy administration is among the most difficult research subjects in tackling the problem of escalating power usage. Data centres have been the focus of much research because they consume immense quantities of electric power, coupled with relatively significant costs and carbon footprints [3]. Any initiatives and ideas that can considerably cut data centre energy use while also contributing to higher environmental sustainability [4] are welcome. However, focusing solely on reducing energy usage is insufficient because it may compromise other goals such

Table1. Energy-aware data classification techniques taxonomy.

Literature	Criterion for Data	Zones	Environment	Effectiveness in energy	Publication
Sustainable HDFS: Aiming for an energy-efficient, memory, heterogeneous Hadoop cluster [21]	Data's spatial temporal popularity	Cold zone and hot zone	Hadoop cluster at yahoo	Average 26% energy reduction	2010
Green cloud - based data centres require a dynamic data gathering technique [22]	Data's access pattern	Similar data access pattern aggregation stored	Simulated Data center	43.06% energy consumption conserved	2012
For a cloud infrastructure, an energy-efficient technique based on data categorization is used [24]	Data's repetition and activity factor	ColdZone, Hot zone and ReduplicationZone	CloudSim simulator	Over 35% energy consumption saved	2014
Adaptive Energy-Aware Approaches for Cloud Technology to Consume Less Energy and SLA Violation [23]	Network traffic	Consolidation of virtual machines based on workload status	CloudSim Simulator	Average 12% energy saved and 22% SLA violation reduced	2018

as QoS and scalability. As a result, dealing with multi-objective tradeoffs is another important challenge. Despite these obstacles, virtualization technology has long been recognized as a powerful tool for improving cloud data centre energy efficiency while also achieving other goals. Many solutions have been presented to deal with virtualization successfully and efficiently [4]. Energy-aware variable allocation of resources, energy-efficient task scheduling, and energy-aware workload aggregation are all examples of energy-aware technologies [5], as well as virtual machine consolidation[6], and efficient energy aware data storage [21] are among the solutions.

Cloud Computing

Infrastructure as a service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) are some of the computing services supplied by cloud computing to cloud consumers [4]. The IaaS layer is in charge of administering physical computers and pooling virtual processing and storage resources. Operation systems and development tools make up the PaaS layer. The SaaS layer, on the other hand, houses the real cloud service. In addition, the IaaS can be subdivided into three tiers. To begin, there is a stratum of physical resources, which consists of a standard cloud centre that incorporates both IT and non-IT apparatus (e.g. discs, network equipment, and servers, also for cooling, lightening, and air conditioner). Second, there is the virtualized layer, which is made up of many virtual storage and management of resources made possible by virtualization technology. Finally, there's the management tool layer, which includes features like virtual resource management, accounting, and monitoring. Furthermore, some academics bifurcate services of cloud categories into: one as Service based on hardware (HaaS) and another Service using data (DaaS) [7].

Virtualization

Cloud computing isolates technology and services, allowing multiple cloud apps to share servers almost anywhere in the world. This is doable as long as the technology is virtualized. Virtualizing a programme for the cloud includes bundling the app's assets with everything that they want to execute, including a database, middleware, and operating system. This conscience virtualized program component can then be accessed from any location on the planet. Virtualization can also be used to construct sandboxes. Sandboxes are a type of container that allows applications to run safely, ensuring a greater level of security and stability. It is indeed typically used to "run experimental code or applications from unscrupulous third-party sources."

Load Balancing

The success of cloud-based systems depends on load balancing. It's in charge of equitably spreading work tasks among computers and other devices, allowing resources to be used more economically while also enhancing availability and reliability. A load balancer can handle different amounts of demand automatically by attempting to change its deployment decisions based on when a query is received. In digitalization, where the notion of load balancing is controlled by an application, a load balancing solution is widely utilized.

Efficient Energy aware Strategies for cutback

Making the switch for host and adaptive voltage and frequency scaling(DVFS) are the two key energy-saving methods employed in Cloud-related research.. Energy consumption is lowered by turning off idle hosts, and the system replies to queries with the available hosts. Mao et al [8] The technique of turning hosts on and off was researched and expanded upon by Mao and Humphrey [9], who explored the impact on timelines and cost. The prominence of efficiency gains obtained by shutting down nodes may be attributed to the fact that an inactive host uses approximately 70% of its peak output. [10-11]. When hosts are re-enabled, there is a limited period of high point energy use and possibly technical difficulties. DVFS saves energy by lowering host frequency while keeping them interested. A stringent DVFS approach decreases processor frequency to the point that time restrictions are barely satisfied, potentially resulting in system timeline breaches. However, server changing and frequency modifications have been demonstrated to be successful [12] and are extensively employed.

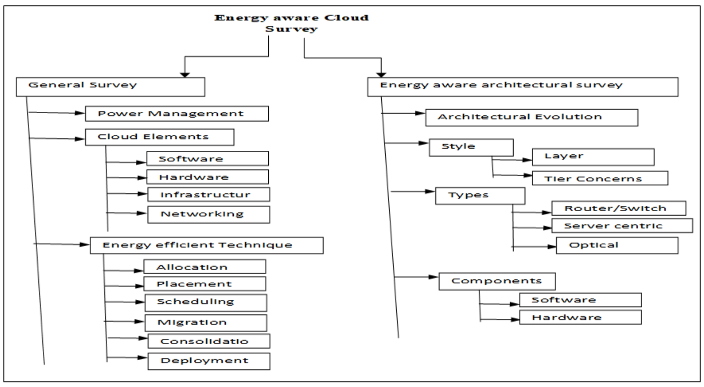

Fig 1. Study on energy-conscious cloud computing are classified.

Energy sensitive Architectural and General Cloud literature

Researchers picked the number of surveys on such topic, particularly stated in [13] [4]. We will now go through each of them in more detail. Power management is a critical facet of an energy-conscious feasible solution. The chosen articles conducted research on this topic. To begin, Beloglazov et al. [14] introduced a range of classifications for managing cloud computing capacity. Management of Stable and Variable Power are of greater importance in computer system classification. Dynamic Component Deactivation and Dynamic Performance Scaling are two categories in the hardware taxonomy. The operating system level taxonomy is divided into numerous dimensions (including application changes, target management systems, and power action plans), and the data centre level workload.

Furthermore, Raj and Shriram [16] emphasised the collaboration of IT and non-IT elements of the system. A characterization of power management strategies has been addressed from a variety of perspectives, including application, cluster layout, hardware resources, and some other infra levels.

This is now According to Jing et al. [4], who concentrated on cloud elements defined as IT (e.g., cpu, system, disk, connectivity) and non-IT gear (Lightining arrestors, air coolling). These variables were then utilised to classify the current approaches. Scheduling algorithm [15], voltage adjustment, and VM relocation are among the IT-equipment strategies mentioned. Meanwhile, non-IT equipment approaches include effective thermal management at two levels: framework and facility. The facility level of the data centre is focused with regulating the circulation of cooling air. The framework handles workload server distribution enhancement in order to decrease cooling requirements.

[19, 17] examined energy-aware resource allocation, whereas [18] discussed VM placement approaches with an eye on energy efficiency. Each piece of art has now been given a brief summary. Existing energy-efficient resource provisioning strategies based on hardware and software, as described by Hameed et al. [19]. They divided current approaches into four levels and mentioned the benefits and drawbacks of each technique. The sustainability in terms of source of energy phases, optimization method, allocation technique, collaboration and accumulation procedure.

Madni et al. [17] published a study in which they performed a systematic review with an emphasis on the platform layer of the cloud, which incorporates energy concerns. The review categorises and discusses previous publications, as well as the resource aspects and characteristics covered in research has been reported. The classification is based on two fundamental dimensions: competitive approach (AI, dynamic, and predictive) and parametric (QoS load balancing, throughput, and energy-aware) allocation of resources.

Attaoui and Sabir [18] investigated Vm allocation algorithms as well, but their focus was on multi-objective improvement, which included energy savings. They talked about cutting-edge work from five different points of view: power, budget, traffic patterns, material, and QoS. They also addressed previously proposed algorithms, such as algorithms for contextual, structured, and educated guess. According to the review's inferences, heuristic and/or meta-heuristic optimization choice is important while it may present high-eminence solutions.

The article [20] examined energy-conscious structures. This may be summarised as follows: Hammadi and Mhamdi [20] explored data centre network architecture development and energy efficiency. Existing data centre network topologies were divided into two basic categories: digital data centres and optical data centres. The digital data centre has two topologies. The typical data centre, also known as a switch-centric data centre, is the first. The second design is the server-centric architecture, which is built on packet-switched electronic networks. Meanwhile, for switching, routing, and connecting, the optical data centre is broadly supported by a variety of passive and active optical devices.

Recommendations

There is a need for various facets of conducting study which is critical in order to inculcate energy-aware cloud exploration. As a result, the following potential areas are suggested:

The survey's focus is on alternative fuels and intelligent systems. Recent surveys are devoid of initiatives that include machine learning and alternative fuels into account. Another study emphasis on energy-aware forecasting using deep learning. Prediction is critical for enabling proactive solutions for energy-aware cloud computing.

Conclusion

Energy-aware platform is a promising technique field of research in the goal of environmentally friendly cloud computing. As a consequence, this work adds to the evaluation of existing relevant surveys and technique ideas for energy efficiency. We established two key categories for classifying current surveys based on our findings: (i) overall energy-conscious cloud surveys and (ii) Studies on energy-efficient design.

In addition, we have proposed numerous potential paths for energy-aware cloud reviews. These guidelines were created by considering the existing survey categories as well as new research efforts. To begin, we suggest focusing a poll on artificial intelligence and renewable energy. Second, we present a survey review on deep learning for energy-aware prediction.

References

[1] F Owusu and C Pattinson. The Current State of Understanding of the Energy Efficiency of Cloud Computing. in 2012 IEEE 11th International Conference on Trust, Security and Privacy in Computing and Communications. 2012: 1948–1953.

[2] Envantage. Cloud computing saves energy on huge scale, says new study. http://www.envantage.co.uk/cloud-computing-saves-energy-on-huge-scale-says-new-study.html. Accessed May 12, 2018.

[3] A Beloglazov, J Abawajy, and R Buyya. Energy-aware resource allocation heuristics for efficient management of data centers for Cloud computing. Futur. Gener. Comput. Syst. 2012; 28(5) 755–768.

[4] SY Jing, S Ali, K She, and Y Zhong. State-of-the-art research study for green cloud computing. J. Supercomput. 2013; 65(1): 445–468.

[5] MK Gourisaria, SS Patra, and PM Khilar. Minimizing Energy Consumption by Task Consolidation in Cloud Centers with Optimized Resource Utilization. Int. J. Electr. Comput. Eng. 2016; 6(6): 3283–3292.

[6] F Farahnakian, T Pahikkala, P Liljeberg, J Plosila, NT Hieu, and H Tenhunen. Energy-aware VM Consolidation in Cloud Data Centers Using Utilization Prediction Model. IEEE Trans. Cloud Comput. 2016; Early Access: 1–1.

[7] L Wang et al. Cloud Computing: a Perspective Study. New Gener. Comput. 2010; 28(2): 137–146.

[8]M Mao, J Li and M Humphrey, Cloud Auto-Scaling with Deadline and Budget Constraints, 11th IEEE/ACM International Conference on Grid Computing (GRID), 2010, p. 41-48.

[9]M Mao and M Humphrey, Auto-scaling to Minimize Cost and Meet Application Deadlines in Cloud Workflows, Int. Conf. for High Performance Computing, Networking, Storage and Analysis, 2011, p 49.

[10]X Fan, W D Weber and L A Barroso, Power Provisioning for a Warehouse-Sized Computer, ACM SIGARCH Computer Architecture News, 2007,vol 35, no 2, p. 13-23.

[11]D Kusic, J O Kephart, J E Hanson, N Kandasamy and G Jiang, Power and Performance Management of Virtualized Computing Environments Via Lookahead Control, Cluster Comput, 2009, vol 12, no 1, p. 1-15.

[12]E N M Elnozahy, M Kistler and R Rajamony, Energy-Efficient Server Clusters, Power-Aware Computer Systems, Springer, 2003, p. 179-197.

[13] S Kumar and R Buyya. Green Cloud Computing and Environmental Sustainability. in Harnessing Green It, Chichester, UK: John Wiley & Sons, Ltd. 2012: 315–339.

[14] A Beloglazov, R Buyya, YC Lee, and A Zomaya. A Taxonomy and Survey of Energy-Efficient Data Centers and Cloud Computing Systems. Adv. Comput. 2011; 82: 47–111.

[15] KK Chakravarthi and V Vijayakumar. Workflow Scheduling Techniques and Algorithms in IaaS Cloud: A Survey. Int. J. Electr. Comput. Eng. 2018; 8(2): 853.

[16] VKM Raj and R Shriram. Power management in virtualized datacenter – A survey. J. Netw. Comput. Appl. 2016; 69: 117–133.

[17] SHH Madni, MSA Latiff, Y Coulibaly, and SM Abdulhamid. Recent advancements in resource allocation techniques for cloud computing environment: a systematic review. Cluster Comput. 2017; 20(3): 2489–2533.

[18] W Attaoui and E Sabir. Multi-Criteria Virtual Machine Placement in Cloud Computing Environments: A literature Review. 2018.

[19] A Hameed et al. A survey and taxonomy on energy efficient resource allocation techniques for cloud computing systems. Computing. 2016; 98(7): 751–774.

[20] A Hammadi and L Mhamdi. A survey on architectures and energy efficiency in Data Center Networks. Comput. Commun. 2014; 40: 1–21.

[21] R. T. Kaushik and M. Bhandarkar, "GreenHDFS: Towards an energyconserving, storage-efficient, hybrid Hadoop compute cluster" in Proc. Int. Conf. Power Aware Comput. Syst. (HotPower). Berkeley, CA, USA: USENIX Association, 2010 pp. 1-9.

[22] X. L. Xu, G. Yang, L. J. Li, and R. C.Wang, "Dynamic data aggregation algorithm for data centers of green cloud computing"' Syst. Eng. Electron. 2012, vol. 34, no. 9, pp. 1923-1929.

[23] R. Yadav, W. Zhang, O. Kaiwartya, P. R. Singh, I. A. Elgendy, and Y. C. Tian, "Adaptive energy-aware algorithms for minimizing energy consumption and SLA violation in cloud computing"' IEEE Access, 2018, vol. 6, pp. 55923-55936.

[24] T. Zhang, B. Liao, H. Sun, F. G. Li, and J. H. Ji, "Energy-efficient algorithm based on data classification for cloud storage system" J. Comput. Appl. 2014, vol. 34, no. 8, pp. 2267-2273.