A Review on Virtual Machine Positioning and Consolidation Strategies for Energy Efficiency in Cloud Data Centers

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Abstract—**The cloud data center consumes massively more and more energy which is considered inacceptable. Therefore further efforts are needed to improve the energy efficiency of such data centers by using Server Consolidation to minimize the number of Active Physical Machines (APMs) in a data center setting. Strategies for positioning and transformation of VM maintain their usefulness as a roadmap to maximum consolidation. The latest techniques do complex restructuring, thus optimizing VM's positioning. The paper provides a detailed state-of - the-art strategies for VM positioning and consolidation that help improve energy efficiency in cloud data centers. A comparison is provided here between the strategies that revealed the worthiness, limitations and suggestions of strengthening other methods along the way.**

Keywords—Energy efficiency; optimization; cloud data centers

I. INTRODUCTION

Cloud data centers result in high energy consumption and a significant amount of carbon footprints are generated which can be described as the 21st century's biggest challenge. The data center environment is the network that physically houses Cloud computing resources and services (L. Zhang, Yin, Li, & Wu, 2015). One of the main reasons for cloud computing's diverse views is that while new technical ideas, new technology, cloud computing has a traditional operating model that brings together a variety of current business management technologies [1, 2]. With a lot of affordable cloud services, and pay as you go. There is a need to at all times have a cheaper, secure, open service with a high demand for cloud service infrastructure and pay as per you go service[3]. Three significant services are made available by the cloud to the user via the Internet. Computing infrastructure as a service (IaaS), with services such as Amazon Elastic Compute Cloud, being supported. Platform as a service (PaaS) to an application of runtime applications, like the Google App Engine[4]. Though Salesforce.com, for instance[5], Software as a Service (SaaS).Although most of these services are provided through virtualization. Virtualization enables the multiple occurrences method to run on one computer[6].Making them shareable among multiple physical users is an abstraction over physical resources [7]. Physical resources are homogeneously virtualized and are therefore efficient for parallel and distributed computing [8]. Distributed cloud systems usually consisting of distributed interconnected data centers, thus using virtualization technologies to provide computing and storage resources for each request on demand [9].

Although cloud computing makes it easier for companies to benefit greatly from lowering operational and administrative costs, the situation suffers from the issue of high energy usage, which could reduce its benefits [10, 11]. Current studies suggest that data centers produce 78.7 million tons of CO_2, 2% of global emissions [12]. CDCs used up to 100 billion kilowatt hours (kWh) in 2015, sufficient for Washington City in the United States alone[12, 13]. By 2022, this high electricity consumption will spread 150 billion kWh, with a 50 per cent increase[14, 15]. If measuring instruments are not, this energy consumption will increase by 2030 in CDCs to 8,000 terawatt hours (TWh). Several prominent cloud providers, including Google, Amazon, Microsoft and IBM, are positive about achieving zero carbon footprint growth and are looking for new ways to render environmentally friendly CDCs and cloud-based services [16, 17]. Such extraordinary energy consumption will lead to excessive carbon dioxide (CO_2) emissions which contribute to global warming. VM consolidation is one of the most successful and enabling strategies to reduce energy footprints in cloud data centers [18].Virtualization offered support with the coming cloud computing, by which it further corroborated the energies for energy-efficient computing. Reducing power usage and energy indulgence had thus become imperative considerations for developing environmentally friendly cloud services [19]. For data centers, major causes of energy inadequacy are the lack of idle power as ICT devices, such as servers, run as long as the processing and storage space is poor in use [20]. The main objective of cloud service providers is to provide a cost-effective and energy-efficient solution for the virtualization of ICT infrastructure for end-user applications following the Service Level Agreement SLA Quality of Service QoS. However, establishing a specific model of energy consumption for VMs remains an open challenge [21].In these devices, however, energy consumption is more desirable and more so. Although the advent of cloud computing has led to massive resource virtualization, due to growing demand for cloud services, their energy cost remains real and rapidly rising [22]. Some of the big challenges of cloud data center days are the amount of electricity consumed

in a network to complete the application deployment, and the number of workloads executed to the total energy expended by CDC to execute those workloads. The use of energy can be improved if the amount of mechanisms can be increased or reduced to the dynamic power range.. Must of the researcher primarily committed to optimizing the processor and memory energy consumption. Therefore, to spend this research on covering other workloads, such as storage, network bandwidth etc. at the same time, a great deal is needed to facilitate the request of users. This contest of energy efficient cloud services needs to be solved by the future researcher, this can be done by having a good proposal on resource management policies, algorithms, and architectures.

Therefore, because data centers are powered on the combination of grid and renewable energy, it would be wise for cities to save much of their electricity. Consequently, there is a need to handle both resources and QoS effectively together to provide effective Virtual Machine Placement. Most of the current energy-aware resource management techniques and policies focus primarily only on energy-reduction VM server placement, without considering other resources such as networks, storage, memory, and cooling system which consumes huge amounts of energy. This problem can be solved if the energy consumption and SLAs are handled at the same time. Although researchers are currently doing their best on the issue at hand, more is needed to ensure that the Energy-efficient and Service Level Agreement (SLA) is reached at the same time to reduce operating costs and meet the needs of consumers.

II. RELATED WORK

Cloud computing is growing rapidly, hence the need to look at the data center's cost and efficiency. Service providers draw customers who provide this service with high quality at a lower cost and could be achieved if that physical machine energy is also a bargain in demand to fulfill SLA. Indeed my researcher has already started this data center's energy-efficiency policies.

The author in [23] argued that successful energy management is indeed crucial in cloud data centers and therefore appropriate techniques remain important for energy efficient allocation of VMs.

In [24], the author suggested that a constructive way of consolidating would be primarily to explain the VM placement algorithms and procedures used to find an optimal solution to the VM placement issue. These approaches, whichever minimizes power consumption or provides QoS, might be the biggest conflicting target. Ranking these algorithms or selecting the best one could be a very difficult task to suggest since all other placement approaches have specific targets, such as relocation, resources, and powerful parameters. Although it was suggested that these methods might seem outwardly appropriate, some or the other kind of trade-offs still occur when measured in depth.

The author in [25] proposed that the system, given the significant advantages of cloud computing, is still not mature enough to reach its full potential. The various key challenges this area faces, which include automated resource provisioning, power management, and security management that are just starting to get the attention of the research community. For now, huge potential for researchers to make creative contributions in this field will save substantial impact on the growth of the industry.

Author in [19] suggested that energy efficient allocation of resources remains an open challenge. This where it discusses software and hardware-based techniques. The research proposes a taxonomy aspect namely on objective purpose, allocation process, resource adaptation policy, allocation operation, and interoperability.

Author in [26] explore state-of-the-art techniques for maximizing bandwidth, DVF facilitates power management, server consolidation schemes, and methods for optimizing efficiency across WAN connections. Virtual machine migration work critical through an extensive analysis of existing schemes. To conclude, open research questions and trends in the VM migration domain need to be considered to improve further.

It's said that in [27], the extraordinary impertinence that genuine cloud markets are mostly thousands to millions of dynamically generated and destroyed VMs. No agreed criterion for issues with VMP studies depending on the study. And picking up a test question during experimental research should be useful.

The author in [26] proposed a data management and indexation of the big data taxonomy techniques. The aim is to study the indexing needs of big data for the current state-of-the-art probability indexing techniques by providing researchers with a basis for designing improved solutions for a specific field to support heterogeneity, scalability and accuracy of data as a major concern. The study is based on the precision of collaborative artificial intelligence techniques for extracting information. The proposed method is based on indexing techniques for easy indexing and retrieval, which as the major issue of BD-MCC is acceptable for large size data. The methods provide acceptable data recovery rate and accuracy in the cloud, and end users always use and capture data wherever they are.

In [28], the author applied the method cumulative energy efficiency CEE provides for a direct comparison of servers and IT devices used in data center, taking into account all infrastructures and the different stages in its lifecycle, and various operating conditions. Evaluate maximum energy consumption of data center facilities, establishes a resource metric efficiency that allows a comparison of products throughout their entire life cycle in a data center. Where the result can be used to improve design, operation, and end-of-life strategies for decision makers.

The author in [29] used energy-saving strategies at the data center, with an emphasis on the energy efficiency effect of airflow distribution. Bearing in mind the formation of the thermal environment, multi-scale factors affecting the thermal environment simplify and validate thermal models. This would lead to accurately predict and evaluate the thermal environment and to optimize data center thermal environment

have become problems that is important to the data center lifespan.

Author in [14] proposes a Total Energy Management forProfessional Data CentersTEMPRO Analytics framework approach will allow for the preliminary evaluation of the energy efficiency of data centers by means of a visualization with consideration of conformity testing of accredited KPIs. The result shows in some certain areas of data centers, they will be used to optimize overall energy effectiveness. Moreover, it suggested the solution would include different means of visualization for a preliminary evaluation, such as the Sankey diagrams.

III. TAXONOMY OF VIRTUAL MACHINE PLACEMENT TECHNIQUES

There are a number of virtual machine techniques for energy efficiency which have centered in a cloud environment on the subject of energy efficient and resource management. Accordingly, the section contrasts the following dimensions: energy policy adaptation, allocation process and energy usage.

Number of VMP taxonomy for the definition in the literature presented here has been studied. Around 40 research article related to the current study where chosen, with various possible question of formulation. Indeed, selecting the best host to deploy a virtual machine known as VMP is a procedure [30]. These formulations can be either power conscious, or service quality. Consequently, it has also broken down into whether it is an artificially intelligent, non-artificially intelligent or collaborative process of power consumption or service quality.

A. Virtual Machine Placement Policy

Several researchers have tried to work on successful solutions aimed at reducing data center energy consumption while maintaining preferred QoS (Service Quality) [31]. QoS and power saving are two key VM consolidation goals [24]. This type of VM placement method differs from one cloud service provider to another according to the placement target, a VM placement algorithm can generally be divided into two types: Power-based approach with goals of achieving a VM-PM mapping resulting in a system that is energy-efficient with the highest use of resources [32]. While QoS-based a VM placement method varies from one cloud service provider to another.

Indecisions arise from a number of issues that may be resource volume demand (e.g. bandwidth, electricity, and storage space), while failure (e.g., network connection failure and CPU hosting instance failure) and user load configuration (e.g. number of users and location) may occur. The paper is based on the strategy of Virtual Machine Placement Techniques divided into two categories: Power consumption and quality of service as contained in Fig. 1.

Cloud-based Hardware resource status can track e, g. Network, virtual server, and storage while software resources such as application servers, web servers, database servers, etc. all constitute basic functionality and virtual machine placement techniques implementation policies. Monitoring operation includes dynamically profiling the QoS parameters that are connected to the hardware and software resources, the physical resources that are shared while the applications run on them or storing the data. Monitoring services can help to position a virtual machine with respect to: maintaining the energy efficiency level at peak activity for applications and cloud resources, monitoring the energy efficiency and service quality (QoS) provided to the host application, and tracking resource and device failures.

Fig. 2 is a tool that helps you get a perfect understanding of categorizing your organization. Based on the above existing methods, categorized in three categories: NAI, AI, and Hybrid. The latest virtual machine placement strategies that are being analyzed in this survey to see their energy efficiency suitability. Placement strategies are listed in categories as Non-artificial intelligence, artificial intelligence, and hybrid are power consumption and quality of service with subcategories. From the above sub-categorization, AI is based on artificial intelligent power consumption or service quality techniques, for example. Ant colony algorithm, Firefly algorithm, Particle swan algorithm, etc., though NAI is such an algorithm that is not, for example, based on artificial intelligent. Greedy algorithm, Heuristic, Best Fit Decreasing etc. but Hybrid is the combination of artificial and non-artificial intelligent or either called hybrid algorithm.
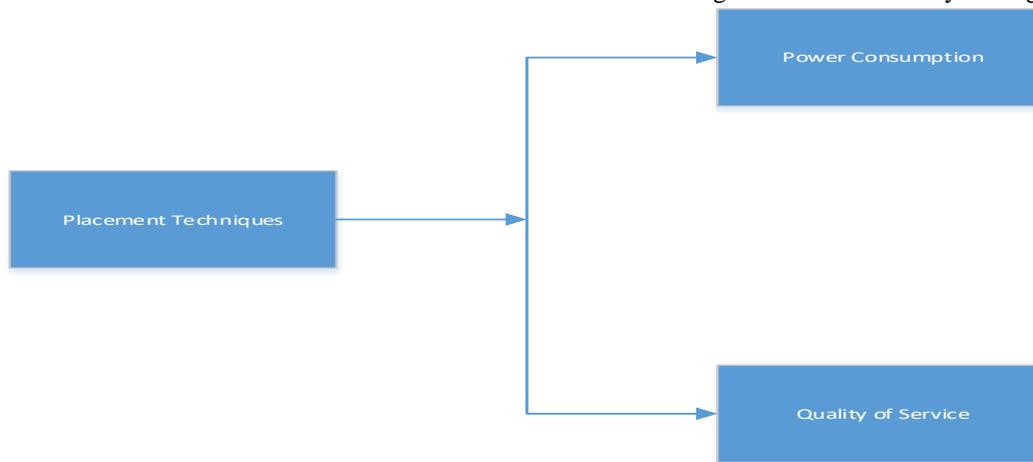

Fig. 1. Types of Placement Techniques.

Placement Techiques

Power Consumption

- Artificial Intelligent
  - Ant Colony Alg. (Geo Y. et el 2013)
  - PS-ES (Zhao J. et el 2014)
  - Order Exchange Migration Ant Colony System (OEMACS) (Liu F.X. et el 2018)
  - Ant Colony Optimization ACS (Zhang L. et el 2016)
  - Hypercube Framework of Ant Colony Optimization (Perumal B. et el 2017)
  - Ant Colony Optimization (Alharbi F, et el 2017)
  - Unified Ant Colony System UACS (Liu X. et el 2017)
  - Ant Colony System ACS (Jayeshree V. et el 2014)
  - Firefly Colony and Fuzzy Firefly Colony Optimization (Perumal B, et el 2016)

- Non Artificial Intellige
  - EAGLE (Li, Xin 2012)
  - Brownout based Approximation Markov Decision (Bayya R. Et El 2017)
  - Branch and Bound Algorithm (Bartok D. et el 2015)
  - Minimum Correlation Coefficient (Xiong F.U. et el 2015)
  - Artificial Neural Network (Jassim H. et al 2017)
  - Cost and Carbon Emission-Efficient VM placement Method (CACEV) (Ahvar E. et al 2016)
  - Shadow Scheme (Yang et al 2014).
  - Cool Cloud (Zhang Z. et al 2015)

- Hybrid
  - Ant Colony Optimization and Multi-Objective Genetic algorithm (Sarma K. A. S et el 2015)
  - Hybrid Genetic Algorithm(Tang M. et el 2014)
  - Ant Colony System and Particle Swarm Optimization (ACS-PSO) (Benita B. J.S. et el 2014)
  - Hybrid Genetic Algorithm (Tang M. and Pan S.2014)
  - Multi- Objective Ant Colony System (Gao Y. et el 2013)

Quality of Service

- Artificial Intelligent
  - Ant Colony Optimization (Ferduas M H, et el 2017)
  - Firefly Algorithm (Jain N. K. et el 2016)
  - Distributed Parallel Genetic Algorithm (DPGA) (Dong Y. et al 2014)
  - Multi Objective Ant Colony (Ashraf A. Ivan P. 2017)

- Non Artificial Intellige
  - VMPLANNER (Weiwei, fang et el 2012)
  - Utility Function (Mosa Abdulkhalik et le 2016)
  - Heuristic Algorithm (Li K. et el 2013)
  - Greedy Algorithm (Ferdaus M. et el 2017)
  - Time Series Forecasting Method and Double Exponential Smoothing (Nikzad S. et el 2016)
  - Heuristic Algorithm (Tajaki M. M et al 2018)
  - Hierarchical VM Placement Scheme (Zhang L. 2015)
  - Function Placement (EVNFP) (Miland G. et al
  - Network Function Virtualization (Chen R. et al 2015)
  - Centrality-based Greedy Algorithm (Bouet M. et al 2015)
  - Network Topology-Aware Redundant VMP (Zhou A. et el 2017)

- Hybrid
  - Hybrid Genetic and Bin Parking (T. Thirivekadam et el 2015)
  - Integer Nonlinear Programing with Efficient Heuristic (Yang S. et el 2015)
  - ATEA(Adaptive Three Threshold Energy- aware Algorithm (Zhuo Z. et el 2016)
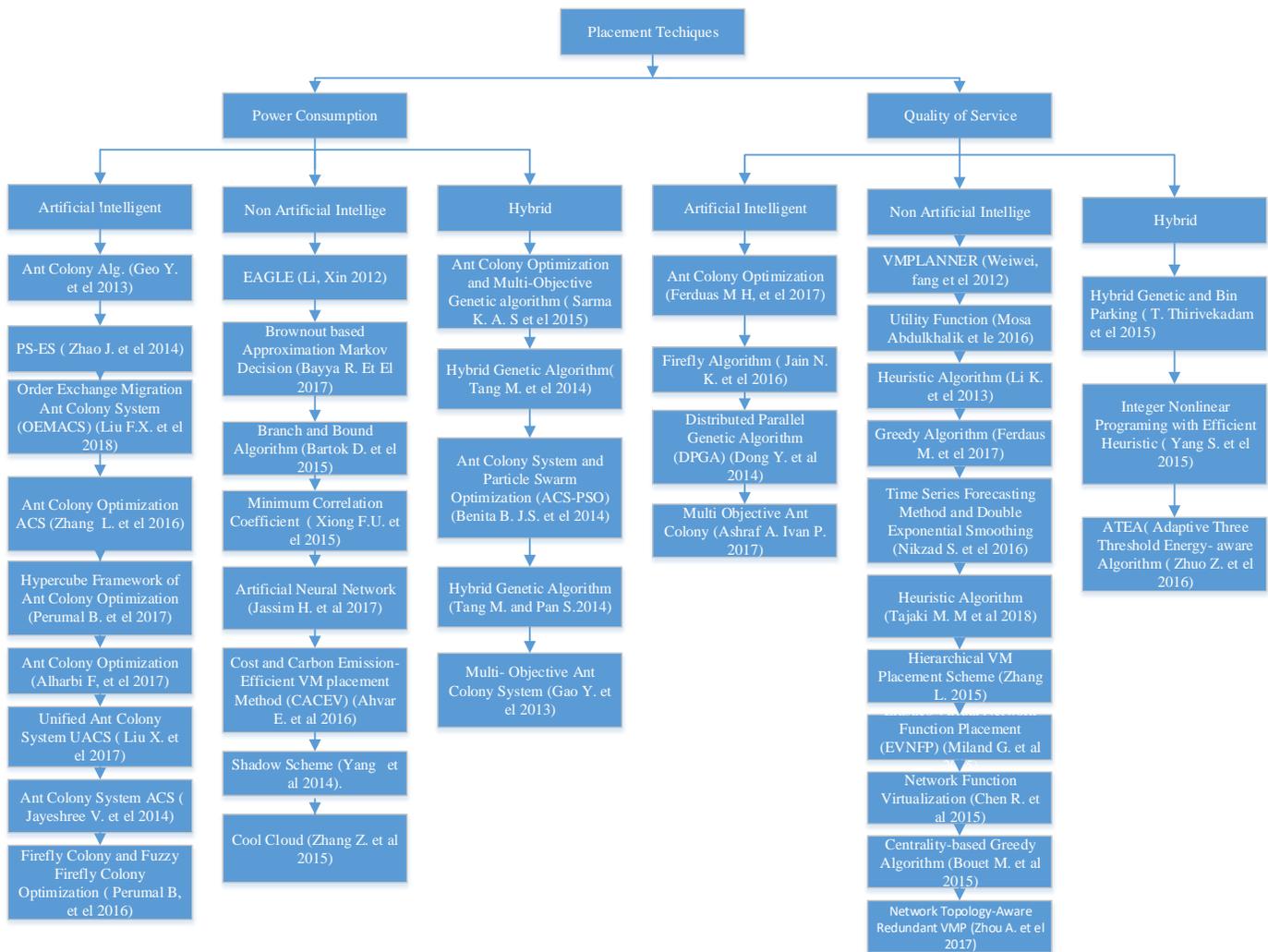
Fig. 2. Taxonomy of Placement Techniques.

Artificial intelligence relates to highly technical and specialized techniques which use the knowledge base when placing a virtual machine to deliver energy efficiency and quality of service. This category is similar to ant colony optimization algorithm, particle swarm algorithm, firefly algorithm, genetic algorithm, etc. This is one of the highly effective methods of power consumption and quality of service in a cloud datacenter.

Non-Artificial Intelligence means placing strategies that are transparent in terms of energy use and quality of service. These techniques are developed mostly for the rapid and efficient placement of virtual machine data. They deploy techniques that include Heuristic optimization algorithm, Greedy algorithm, can best fit, optimizing utility function algorithm, etc. Such non-artificial intelligence strategies are classified as the rule-based automated placement applies only cover-known patterns and cannot identify the data center's unknown behavior.

Hybrid Placement based techniques Hybrid develops energy efficiency and service quality. Such approaches combine AI in a data center to obtain a better supporting solution for virtual machine placement indexing. Some of the techniques in this group are Hybrid Genetic Bin Parking Algorithm, Ant Colony System Particle Swarm optimization, ATEA etc. The significant advantage of the hybrid virtual machine placement classifier is flexibility, so it can be applied to any result of classification (Fig. 3 to 6 graphical representation of the techniques).
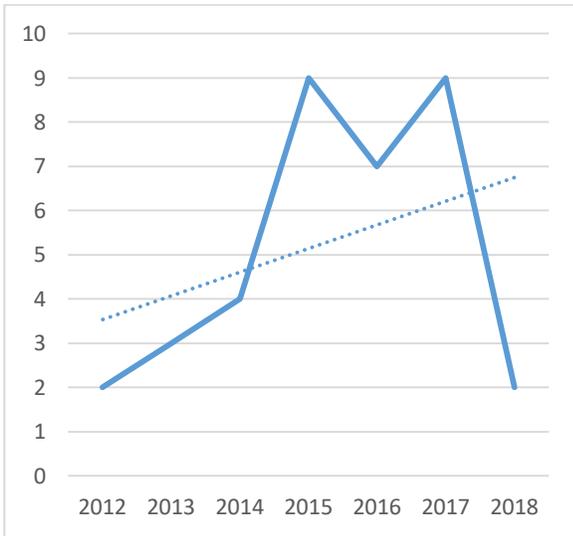
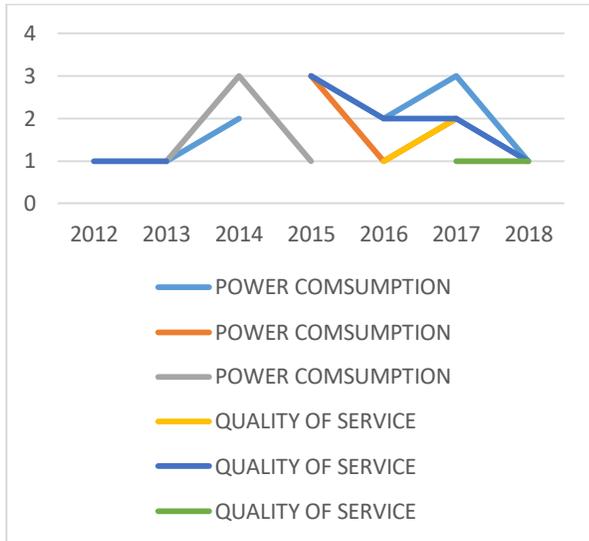Fig. 3.   Virtual Machine Placement Techniques Review Per Year.

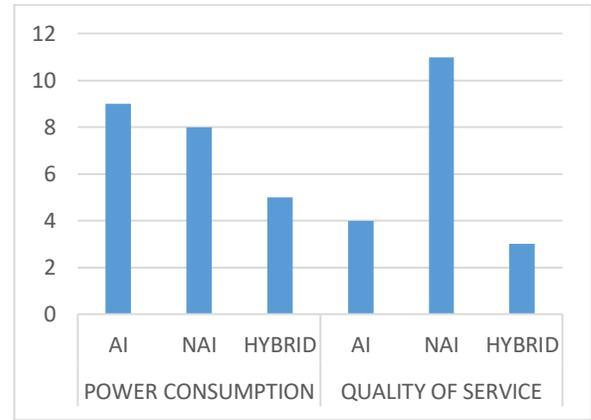Fig. 4.   Per Year Virtual Machine Techniques.

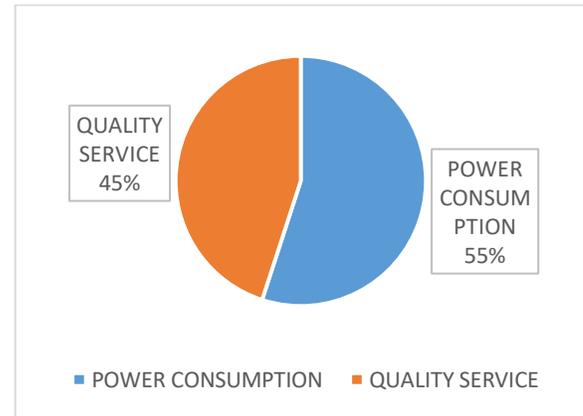Fig. 5.   Types of Virtual Machine Placement Techniques.

Fig. 6.   Virtual Machine Placement Techniques.

IV. PERFORMANCE EVALUATION

As contained in Table I, power-based restructuring allows the efficient use of resources available thereby violating QoS and breaching SLA constraints. Most algorithms therefore find CPU only as their primary resource and should therefore be extended to take into account other important resources which cannot be relegated.

TABLE I.   PERFORMANCE EVALUATION

Author/Date	Metrics	Metrics Parameter	Optimization Parameter	Method Applied	Method objective	Open Research Challenge	Method compared
[33]	Power Optimization	Multi-Objective	CPU and Memory	Order Exchange and Migration Ant Colony System (OEMACS)	Resource efficiency and energy saving	Did not consider the quality of service of the virtual machine resources	Heuristic algorithm
[34]	Quality of Service (QoS)	Multi-Objective	CPU and Memory	Unified Ant Colony System (UACS)	Efficient Virtual Machine Migration and Quality of service	The method does not consider network bandwidth	Heuristic algorithm
[35]	Power Optimization	Multi-Objective	CPU and Memory	Ant Colony System (ACS)	Total energy consumption	The method did not consider network bandwidth quality of service of the resources	Compared with existing Ant Colony Algorithm

[36]	Power Optimization	Multi-Objective	CPU and Memory	Firefly Colony and Fuzzy Colony	Energy efficiency and resource wastage	The approach fails to consider the standard of resource service	Better than Heuristic and metaheuristic algorithms
[37]	Power Optimization	Multi-Objective	CPU and Memory	Multi-objective device for ant colony	Waste of resources, and energy consumption	Didn't consider data center combination issues	Multifunctional genetic algorithm, Bin parking algorithm and Ant Colony algorithm max-min
[38]	Power Optimization	Multi-Objective	CPU and Memory	Hypercube Framework Ant Colony System	Power consumption and resource wastage	Did not take care of Quality of Service of resource	Similar to the ant system Max-Min and Ant colony
[39]	Power Optimization	Hybrid	CPU and Memory	Multi-Objective and Ant Colony System	Power efficiency and resource utilization	Not consider network traffic	Compared with Multi-Objective genetic algorithm
[40]	Quality of Service	Multi-Objective	Network bandwidth	VMPlanner	Traffic demand and capacity supply	The algorithm did not Consider resource utilization	NA
[41]	Quality of Service	Multi-Objective	CPU and Memory	EAGLE	Balance the resource utilization, reduce the running PM and lower the energy consumption	The algorithm did not take care of Network communication of the data center	The algorithm outperforms the first-fit algorithm.
[42]	Quality of Service	Multi-Objective	CPU and Memory	Utility function / Genetic algorithm	Energy optimization and SLA	Did not consider Network traffic of the data center	Capered with Heuristic based algorithm
[43]	Power Optimization	Multi-Objective	CPU and Memory	Ant Colony Optimization (ACO) Metaheuristic	Reduce energy consumption, resource wastage, and migration overhead	The algorithm did consider SLA	Compared with ACO metaheuristic
[44]	Quality of Service	Hybrid	CPU and Memory	Hybrid Genetic algorithm	To reduce resource utilization and SLA	The algorithm did not take care of energy consumption efficiently	Compared with algorithms first fit, best fit and round robin.
[45]	Quality of Service	Hybrid	CPU and Memory	Heuristic algorithm	To reduce job completion time	The proposed algorithm does not consider SLA	Compared with the heuristic algorithms of best fit and first fit
[46]	Quality of Service	Multi-Objective	CPU and Network bandwidth	Network and Data-aware Placement (NDAP)	The proposed algorithm aims to reduce energy consumption and improved network performance by reducing delay on the transmission packet.	The proposed algorithm does not consider SLA	NA
[47]	Quality of Service and Power Optimization	Multi-Objective	CPU and Memory	Modified Best Fit Decreasing Algorithm (MBFD) with clustering	The algorithm lower the energy consumption, Service Level Agreement Violation SLAV, and performance degradation	The proposed algorithm did not consider network traffic in the cloud data center	NA

[48]	Power Optimization	Multi-Objective	CPU and Memory	The proposed a custom branch-and-bound algorithm	The algorithm is to improve the effectiveness of cost, application performance, and energy consumption	The algorithm does not take care of network traffic of the data center	Compared with integer linear programming (ILP)
[49]	Quality of Service and Power Optimization	Multi-Objective	CPU and Memory	Adaptive Three-Threshold Energy-Aware Algorithm(ATEA)	The algorithm aims to improve the energy and Service; level agreement effectively	Is not network traffic aware algorithm	NA
[50]	Power Optimization	Multi-Objective	CPU and Memory	The Proposed Integer Nonlinear Programming (INLP)	The algorithm has better in effectiveness in node ratio and performance	The running time is significantly larger than all the heuristics.	The algorithm is compared with ordinary integer nonlinear programming
[51]	Power Optimization	Multi-Objective	CPU and Memory	The proposed Firefly algorithm	The algorithm have shown better energy efficiency and migration	The weakness of the algorithm does not consider the Service Level Agreement	The algorithm is compared with Ant Colony Optimization (ACO) and First Fit Decreasing (FFD) algorithms
[52]	Power Optimization	Hybrid Objective	CPU and Memory	A hybrid genetic algorithm is proposed	The algorithm is aimed at improving efficiency	The communication network is not taken care	Compared with existing heuristic algorithms
[53]	Power Optimization	Multi-Objective	CPU and Memory	A proposed minimum correlation coefficient	The algorithm aims to reduce energy consumption, migration policy and service level agreement in a cloud data environment	The result shows that network traffic is not considered	The result is compared with PABFD
[33]	Power Optimization	Multi-Objective	CPU and Memory	A proposed Order Exchange and Migration Ant Colony System algorithm	The algorithm minimizing the number of active servers, improving resource utilization, balancing different resources, and reducing power consumption.	Service Level Agreement and Network Traffic is not considered	The algorithm is compared with the Heuristic algorithm
[54]	Power Optimization	Multi-Objective	CPU, Memory, and Bandwidth	A Virtual Machine Placement biogeography-based optimization (VMPBBO) algorithm is proposed	The algorithm takes care of power consumption and resource waste at the same time	The Proposed algorithm does not consider Service Level Agreement (SLA)	Compared with Modified General Greedy Algorithm and Virtual Machine Placement Ant Colony System (MGGA and VMPACS)

[55]	Power Optimization	Multi-Objective	CPU and Memory	The proposed Ant Colony System with Particle Swarm Optimization algorithm (ACS-PSO)	The proposed algorithm aim at minimizing resource wastage, minimizing power consumption and for load balancing in physical servers.	The algorithm does not take care of SLA and Network Traffic	compared with the multi-objective and ant colony system algorithm
[56]	Power consumption and Quality of Service	Multi-Objective	Network bandwidth	Network-topology aware redundant VM placement approach to minimizing the consumption of network resources	The proposed approach is a three-step process: host server selection, optimal redundant VM placement, and recovery strategy decision	The algorithm does not take care of SLA	The algorithm where compared with the heuristic algorithm
[57]	Quality of Service	Multi-Objective	Network bandwidth	Proposed near optimal approximation algorithms	Provide bi-criteria solutions reaching constant approximation factors with respect to the overall performance, and adhering to the capacity constraints of the networking infrastructure by a constant factor as well	The algorithm does not take care of SLA	Compared with many realistic algorithms
[58]	Power consumption and Quality of Service	Multi-Objective	CPU and Memory	A Cool Cloud algorithm is proposed	The algorithm provides better power consumption and load balancing	The algorithm does not take care of SLA	The algorithm compared with ILP and Heuristic
[59]	Quality of Service	Multi-Objective	CPU and Memory	A shadow routing based dynamic	The algorithm shows more energy efficiency	The algorithm does not consider network infrastructure	The algorithm is compared with the heuristic algorithm
	Power Consumption	Multi-Objective	CPU, Bandwidth and Response time	Cielo algorithm	The algorithm theoretically ensures that every application has an evolutionarily stable positioning strategy, which is a constant solution under a given workload and availability of resources in a cloud	The algorithm has less SLA consideration	an Algorithm is compared with the Heuristic algorithm

V. CHALLENGES

Cloud computing is still at a timely stage, as the industry generally agrees, where a researcher can work. There are many issues that have not been fully addressed, as the application of industry poses new challenges. Find this section summarizing some of the difficult issues related to cloud computing science. Virtual machine placement algorithms need to tackle various challenges that come from cloud energy efficiency model characteristics. Discussing these issues, and their role in shaping the versatility and convenience offered by cloud environments. The Clouds ' Quality of Service perspective has been well described as a large pool of virtualized resources (such as hardware, platforms for development, and/or services) that are available and accessible only. Cloud computing's main problems are allocating resources to different end-users who have unique resource demands based on their application patterns. Capacity management is either aimed at improving the application's QoS or Energy efficiency, thus improving energy use. QoS seeks to provide optimized parameters which can be measured in terms of space, time, communication delay and budget.

There is a lot of work that has been checked for the purpose of seeing functionality and restricting them when putting VM in the cloud environment. The techniques were divided into a group which included power consumption and service quality. Since power consumption is aimed at a VM-PM mapping that result in an energy-efficient system with the best use of resources, while QoS-based approach is VM-PM mapping that certifies the highest satisfaction of the requirements for service quality. Verily, almost all of the algorithms differ in the goal, but most of them are common in the achievement of power efficiency, while the rest are for service quality. The energy efficiency is highly required in all data center operators to minimize operating costs as well as there is a need to meet user needs where service quality is subject to consumer SLA requirement. One of the hardest tasks is determining which of the sub-techniques is most important.

The energy-efficiency resource management can be described as a major challenge in managing virtualized resource pools effectively for us cloud computing service providers. Physical resources, such as CPU cores, disk space, and network bandwidth need to be cut and shared for virtual machines running potentially heterogeneous workloads. In addition to enhancing productivity processes, integrated resource management can also improve the use of data centers and thus reduce energy usage. Achieving these can be achieved by carefully consolidating workload on a smaller number of servers and turning off unused resources. This research area therefore has an endless opening for the researcher, and is still in need of more.

A. Security

Safety in cloud computing ensures anonymity for the services offered. This model allows data encryption in order to increase the reliability. The' data encryption software' is used to encrypt and decrypt. Service providers are recommended to have the accuracy and reliability of data encryption. Through requesting the key from the key cloud server (KCS), this function can be accomplished through increasing the reliability and the encryption processes. One of the functionality of access control management (ACM) is to approve and authenticate users who access the cloud. Just approved users are allowed to access the cloud to prevent it from attacking. To order to avoid these issues, an intrusion detection program must be used to detect and only allow users to reduce the difficulty.

B. Scalability

These are the device's functionalities for operating as specified. Cloud computing is adapting its cost-effective approach to increasing demands. There are various scaling types available including vertical scaling, horizontal scaling and diagonal scaling [60]. To test the virtual machine (VM) scalability based on the multi-core system workloads. For the VMs message workload control protocol (TCP), scalability is constrained as compared to multiple threads. To order to improve scalability, other computing areas will require a lot of focus, such as memory architecture, network architecture and overhead computing.

C. Data Integrity

Data integrity is the framework that offers scalability, position-independent and a reliable forum for the client. To have data integrity, we need two things which are protection and performance based on public, private key and secret key generation. Confidentiality of information is secured as we encrypt data to prevent unauthorized users [61]. To verify data storage correction and prevent error a universal hash function is required. Recovery is accomplished without mistake, by maintaining confidentiality.

VI. FUTURE DIRECTION

A coal generating carbon emissions which are detrimental to both humans and the environment is the most recent major source of energy production. Energy consumption is a concern that has been widely recognized in the ICT sector throughout the ICT infrastructure such as a datacenter. To have an efficient cloud computing infrastructure, a scalable design was required that could support in particular the reduction of greenhouse gas (GHG) transmissions in and energy consumption. The high increase in ICT resource and its density directly impacts users' spending more on data center infrastructure as well as on cooling and energy management.

The transfer of data removes delays and reduces power consumption, and the contact pattern between CPUs is important to observe. In fact putting CPUs on the same servers, or similar to them, takes a lot of work. In addition to the energy-efficient VM placement algorithms, the application interface can provide different performance levels for end-users. However, in cloud computing, QoS-conscious VM allocation policies also play a major role. A comprehensive study is needed to identify specific patterns of behavior by cloud and distribution of workloads. Further effort is needed to find the relationship between varying workloads, while an effort should be made to create structures that can minimize SLA trade-offs and provide energy efficiency algorithms. Given the increasing deployment of large-scale, complex workflow applications, cloud computing hosts face more critical challenges in reducing consumption without infringing a certain quality of service.

VM placement has done a virtualized datacenter that can be reconfigured by live migration to preserve operational efficiency as the selection of needed VMs changes over time. It is based on the above comparison and taxonomy, it can be understood that in a cloud computing environment, there are specific holes that are wet to be filled and can open up challenges in the field of energy efficiency. The power consumption reports 55 percent in the literature, while 45 percent is reported as service quality, which demonstrates that there is still a great need to look at the power consumption field in order to be able to provide efficient service to customer needs. To maximize customer satisfaction, there is a need to match power consumption with the quality of service in order to have better service delivery. Hybrid algorithms are needed for simplification to facilitate the resolution of many multi-objective problems.

Most of the existing energy-aware resource management approaches and policies focus primarily on VM consolidation

to minimize server power consumption only, without considering other resources such as networks, storage, memory, and cooling, which consumes a huge amount of energy. This is one of the big open research problems for the cloud computing community as geographic resource distribution influences network QoS. Unfortunately, the immense amount of simultaneous high-performance data can also consume large amounts of energy. SLAs and QoS t need better energy efficiency at the data center simultaneously to tackle this energy problem. The research community is called upon to do more to ensure energy efficiency and service quality of the cloud data center in order to work towards this direction.

VII. CONCLUSION

Energy-efficient VM positioning techniques have in years become one of the main research areas at the data center. In defining the power, quality of service, energy in hardware and software, and categorizing existing literature techniques along with a description of their characteristics and constraints. The paper provides the cloud data center with a categorization of current VM positioning strategies and algorithms. The goal is to determine the VM placement requirements for data from cloud data centers and to present a state-of - the-art potential algorithm that would provide researchers with a basis for designing enhanced solutions in a particular domain to provide flexibility, accuracy and scalability to cloud computing.

Additionally, cloud computing will support the business community due to a large number of cloud services users including mobile apps, online gaming, social media, and email. Cloud services need to be made more energy-efficient and sustainable in this respect which can meet consumer demands in a timely manner without affecting the climate. In addition, to enable energy-efficient cloud services, both energy and QoS must be handled jointly.

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