Service Level Agreement (SLA) for Cloud Computing for Ensuring Energy Efficiency in Green Data Centres: An Analysis

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Abstract: Cloud computing conveys scalable and on-demand services to huge set of users in variety of domains all over the world. Thus it has been revolutionized the strategy used for employing distributed services to various business as well as government organizations. As the popularity increases, the complication of the cloud environment is also increasing at an enormous degree. Though, this novel technique has produced many issues not only for service providers, but also for customers, who have already been owned complicated legacy systems. This paper analyses SLA management related to cloud computing. The work begin with an investigation of cloud computing architecture. Then, we discuss existing structure, metrics, penalties etc. of Service Level Agreements in various cloud services models such as SaaS, PaaS and IaaS. Subsequently we analyses the Energy Aware SLA which is the extension of existing Cloud SLA in which as an additional, it includes energy and carbon parameters. In the last section, we summarize our findings as a conclusion.

Keywords: Cloud Computing, Service Level Agreement, Green Cloud Computing,Virtualization, Cloud SLA, SLA life cycle, SLA metrics, Energy Aware SLA

I. INTRODUCTION

Cloud computing is a new technology for providing elastic resources in the category of computing services such as software, databases servers, storage, networking, analytics etc. on demand to its enormous number of customers from geographically dispersed area with 24X7 in 365 days through common internet protocols. Companies contributing these services are called cloud service providers and normally they are in charge for cloud computing services depend on usage, similar to the other utility service payment like water, telephone or electricity at home on metered basis[1]. Cloud provides Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) as service models. While the popularity of the cloud computing in every fields increases, whether it is a multinational company or sole proprietary ship or whether it is public or private organization or whether it is official or personal affairs, the various cloud service providers such as Google, Microsoft, Yahoo, Apple, Amazon etc. are persuading to deploy large number of energy hungry data centres in different geographical area all over the world.

Each data centre is a centralized repository consists of thousands of physical machines arranged in hundreds of racks that can run millions of Virtual Machines. It could consume as much power as a small hydroelectric power station could produce. The environmental impact is the CO_2 emission, which makes up greatest share of the Green house Gas (GHG) into the atmosphere. According to the report of European Union, before the year 2020 to keep the global temperature increase below 2 °C, a decrease in CO_2 emission volume of 15%-30% is required [2].

Green computing or green technology refers to the environmentally responsible use of computers and any other technology related resources. As a result of such potential impacts to the atmosphere, the green cloud computing initiative has emerged as part of the green IT vision. Green Cloud Computing is the grand total of the essence of Green Computing with Cloud Computing. Green Cloud Computing is envisaged to attain not only efficient processing and proper utilization of computing infrastructure, but also minimize energy consumption. It presents a simulation environment for energy aware cloud computing data centers [3].

To ascertain this sort of high power computing platform, from multiple provinces dynamically integrating and provisioning of cloud resources guides to many challenges either within the organization or in between organizations. Though Cloud computing needs a clear cut agreement called Service Level Agreement(SLA) which is employed as a proper contract between Cloud consumers and Cloud Service Providers to make sure the quality of services. Unlike other utility services, there

are no general standard exists for service level agreement (SLA) in cloud computing[4]. Recently, many research works are conducting to define a faultless SLA for cloud computing. SLAs in cloud includes different requirements concerning security, pricing, performance, customer level satisfaction (CLS) and SLA violation.

Prior to signing in SLA ensures that the cloud platform is suitable for the activities which is providing all the requirements which one needed. Section II analyses related works. In Section III, we are discussing cloud computing architecture. In section IV, discusses about the fundamentals of Sevice Level Agreement. In Section V, we presents Cloud SLA key factors regarding SLA metrics. In Section VI, We are discussing most prominent Extension of Cloud SLA, i.e., Energy Aware SLA. In Section VII, we are analyzing the SLA penalties and finally, in Section VIII, discussion part is including conclusion regarding our work.

II. RELATED WORK

At present, several efficient quotable researches are carrying out in the region of improving energy efficiency though proper utilization of resources in cloud data centres. It will helps to reduce the green house gas such as CO2 emission and made an eco friendly IT structure. More over, the efficient usage of resources in cloud environment will noticeably reduce the Service Level Agreement violations. In this section, we review significant attempts suggested in the literature for attaining energy efficiency and improving SLA via proper resource utilization in cloud data centers.

Hassan, M. K et.al[5], have been proposed a machine learning technique with modified kernel along with Friedman rank summation and average ranking for VMs live migrations based on adaptive prediction of utilization thresholds.It will ensure the QoS and SLA in virtualized cloud based data centers for critical applications with strict SLA.

Mustafa, S et al[6], have been presented two algorithms named Available Capacity and Power (ACP) and Required Capacity and Power (RCP) through which a server is opted for the basis of available CPU capacity and the energy that will be consumed for that capacity. While using the historical data and intelligently changing the values of the data based on varying workloads, it helps to achieve dynamic VM consolidation. They proved through the experimental result that it reduced the energy consumption as a consequence reducing the SLA violation due to the proper use of resources.

Su, W. et al.[7]have been evaluated balanced SLA-aware tenant placement (BSP) algorithm by taking the benefit of the resource sharing. They have been developed a queuing network model to expose the tailored demanding of multi-tenant SaaS. As a result it reduced both over provisioning of resources and violation of SLA.

Anan, M. et al.[8] have been implemented an energy efficient computing framework- Dynamic Migration Algorithm(DMA)- for green cloud datacenters that develops energy efficiency, decreases operational costs, and assembles required Quality of Service (QoS).Through this algorithm, Virtual Machines in servers utilizes the data centres' servers privileged order. This automatically reducing the SLA violation via over deployment of resources.

Zhang, J et al.[9] have been formulated a multi-objective nonlinear programming considering server cost and network cost aspects concurrently in broad constraints, where VMs are either independent or correlated and both of them can be heterogeneous. Similarity based checking will helps to deploy the similar VMs to the remaining PM capacity which will reduced the fragment leak. This algorithm guarantees the QoS parameters while saving cost and obviously minimizes the SLA violation.

Jungmin, S. et al.[10], have proposed Dynamic Overbooking algorithm which jointly controls virtualization potentials and Software Defined Networking (SDN) for VM with traffic consolidation. Through Network overbooking facility, SDN can combine network traffic and manage Quality of Service (QoS) dynamically. In this approach they approximated resource allocation ratio based on the past data monitoring from the online investigation of the physical host as well as network consumption without any prior-knowledge about the workloads. They can be gained energy efficiency and a massive energy cost reduction by minimizing the misuse of excess provisioned resources, then together reduced the SLA violation by distributing adequate resources for the real workload.

Nguyen T. H et al.[11], have presented a VM Consolidation algorithm with multiple Usage Prediction (VMCUP-M) for enhancing power effectiveness in cloud data centres. It considers the various resource types and its estimated utilization. While using the actual and predicted utilization, it is easy to identify the overloaded and under loaded hosts in data centres. This algorithm proves better in reduction of workload in individual host and providing energy efficiency while preserving SLA.

Mohammad,A.K.,et.al.[12], have presented energy efficient and SLA-aware dynamic VM consolidation Mechanism (PCM) Algorithm which is the combination of four algorithms: Over loading host detection algorithm, Underloading host detection, VM Selection and VM Placement algorithms. In their approach they consider multiple parameters for predicting the future host

utilization as RAM, CPU and network Bandwidth. They proved the efficiency of their algorithm through simulation with other four benchmarking algorithms by improving energy efficiency and avoiding SLA violation.

Valerie, D.J. et al.[13]have explored an innovative mathematical model, called CB_ OPT_ SLA, that cut downs the carbon footprint of an InterCloud environment. This model guides to optimal configurations with minimal CO_2 emissions in a single cloud, as well as in an InterCloud environment, and producing a saving up to 65% that traditional model. Moreover, it proves that it yields the reduced rate of carbon foot print and prevent SLA violation while performing VM consolidation.

Fahimeh Farahnakian et al.[14] have investigated Utilization Prediction aware VM Consolidation (UPVMC) - a Dynamic VM consolidation approach which creates a VM consolidation as a way of multiobjective vector been packing problem. By the advent of a regression-based prediction model which is exercised for the prediction of current as well as prospect resource utilization by consolidating the VMs into the decreased number of active PMs. VM selection consider MMT (minimum migration time) strategy and VM allocation consider Modified Power Aware Best Fit Decreasing with SLA as an vital factor.

III. CLOUD COMPUTING

Cloud computing is the on-demand release of computing power, applications,database storage, and other IT resources through a cloud services platform via the internet with pay-as-you-go pricing. According to National Standards and Technology (NIST) , Cloud computing is:[15]

- An on-demand access of network , that's why it is ubiquitous and convenient.
- Have the behavior of accessing a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services)
- Have the capacity of rapidly provisioned and released with minimal management effort or service provider interaction.
- The cloud model is composes of:
  - ❖ Five essential characteristics such as:
    - ➢ On-demand self-service: A customer can self-provision the infrastructure, platform application or storage without human interaction.
    - ➢ Broad network access: Must have reachability and platform options (including thin and thick clients, phones, tablets).
    - ➢ Resource pooling: Resources of cloud technology such as storage, processing, memory, network bandwidth, and virtual machines, which are pooled to serve numerous customers employing a multi-tenant model with diverse physical and virtual resources dynamically allocated or reallocated in agreement with consumer demand.
    - ➢ Rapid elasticity: It must support rapid elasticity with the ability to grow and shrink based on policy, with no impact to applications or users.
    - ➢ Measured service: Highly economical cloud services provisions are metered by performance with a pay-as-you-go pricing model.
  - ❖ Three service models. They are:
    - ➢ Software as a Service (SaaS): It refers to a cloud service which helps consumers access software applications online. These applications are hosted on the cloud and used for multiple purposes by companies as well as individuals. Eg: G-mail
    - ➢ Platform as a Service (PaaS): It is a category of cloud computing that provides a platform and environment to allow developers to build applications and services over the internet. PaaS services are hosted in the cloud and accessed by users simply via their web browser. Eg: Salesforce.com
    - ➢ Infrastructure as a Service (IaaS): It is the next step down from Platform as a Service (PaaS) and two steps down from Software as a Service (SaaS) in the Cloud Computing Stack. Instead of ready-made applications or services, development tools, databases, etc., IaaS provides the underlying operating systems, security, networking, and servers for developing such applications, services, and for deploying development tools, databases, etc. Eg: *Amazon EC2*
  - ❖ Four deployment models and they are:
    - ➢ Private Cloud: Here cloud is operated by an organization and is managed by the owner or by a third party. and may exist on-premises or off-premises. E.g.: HP Data Center
    - ➢ Public Cloud: Here cloud services are available to public. The cloud is usually owned by an organization providing services. E.g.: Amazon
    - ➢ Community Cloud : Here different organizations having similar mission, security requirements and policies collaborate to form a cloud which is either managed by one of the organizations in community or by a third party and may exist on-premises or off-premises. E.g.: HIPAA
    - ➢ Hybrid Cloud: It is a combination of any of the above mentioned clouds that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds). E.g.: ERP in private, Sales & E-mail in Public

III. a. The Configuration of The Cloud Computing Procedure

Cloud users or on behalf of them, their brokers submit service requests from anywhere in the world to the Cloud. It is important to notice that there can be a difference between Cloud consumers and users of deployed services. For instance, a consumer can be a company deploying a Web application, which presents varying workload according to the number of "users" accessing it.

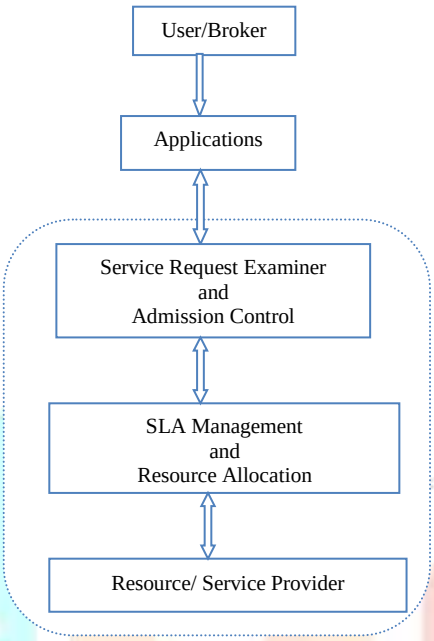

Fig 1: Fundamental architecture of Cloud Computing model

Cloud Users or on behalf of their Brokers communicate with the utility computing services through applications to submit a request from anywhere in the world to the cloud at the first layer. (Fig 1). When a request is submitted Service Request Examiner (SRE) uses Admission Control (AC) mechanism to interpret and investigate the service constraints of a proposed request before deciding whether to admit or refuse it. Subsequently, Resource Allocation is performed by Management layer which consults with the consumers/brokers to settle the SLA with specified prices and penalties (for violations of SLA) between the Cloud service provider and consumer based on the some criteria such as, QoS requirements ,energy saving schemes, security, performance etc. below the SRE. Finally, resources or services are allocated by Service Provider. Cloud functions have a wide categories of workload forms that are requested by the cloud consumers, ranging from High Performance Computing (HPC) to net-applications. The Cloud Service Providers (CSP) formulate an SLA deal with clients based on QoS requirements, and they must forfeit with a fine if there is any violation of agreement[16].

III. b. Green Cloud Computing

Green Computing is the strong movement towards a more environmentally prolonged computing or IT, via various studies, practice and observation of proficient and eco-friendly computing concepts. Green computing is required to minimize the power consumption and environmental pollution [4]. The strategies required to access green computing are Virtualization, Cloud computing, Green Data Center and Energy optimization. Green Cloud Computing (GCC) is the grand total of green computing and cloud computing. The main purpose of GCC to improve the energy efficiency and minimize the power usage and use of hazardous as well as toxic materials. GCC is the practice of designing, manufacturing, using and disposing of servers and other peripheral devices like monitors, printers, storage devices etc., effectively and efficiently to reduce the power consumption which will lead to a safe environment.

III. c. Virtualization

Virtualization is a key technology of cloud computing which acts as a powerful tool that improves the power efficiency of data centers by enabling to allow the multiple virtual machines (VMs) to share the physical resources of a single server through server consolidation and better use of computing resources which in turn minimizes the operational cost. A virtual machine (VM) is an instance of an operating system (OS) or an application environment that is installed as software, which acts like a dedicated hardware. The end user has the same experience on a virtual machine as they would have been on an actual machine. Every VM has its own features and consumption of unique amount of energy depending upon the usage of resources and thus emit different

quantities of carbon footprint. The total carbon footprint of the data center is proportional to the energy usage by each host[17]. The configuration of the multiple VMs on the same physical machine helps in consolidating the task and turning off other physical machines which will helps to cut down the energy consumption level to a great extend.

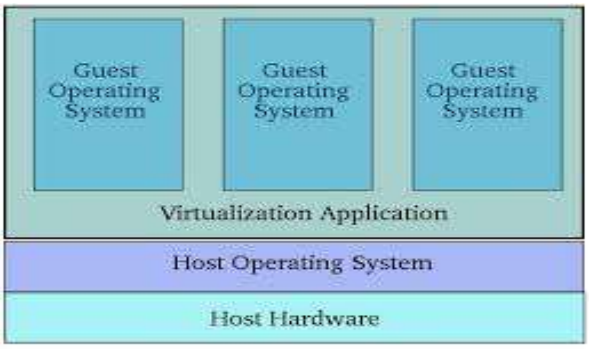

Fig 2: Virtualization diagram

IV. SERVICE LEVEL AGREEMENT(SLA)

Basically, the cloud datacenters must assure higher Quality of Service (QoS) along with consistency to facilitate them commercially thriving in the domain of computing infrastructure. The assertion and assurance fabricated by these cloud datacenters are making a hard copy of this agreement known by the name Service Level Agreements (SLAs). The SLA are much crucial and it must be properly framed in order to pervade the confidence and trust in between its clients and naïve users[18]. An SLA should contain:

- A complete as well as clear definition of services such as its description, standard, duration etc. which the provider offers
- Metrics to be determined whether the provider is delivering the service as assured.
- Evaluation of the services offered by the provider.
- Roles and responsibilities of the provider and the consumer.
- Remedies offered for both the provider as well as the client, if the terms of the SLA are not satisfied.
- An exhaustive description of how the SLA will change over time.

IV. a. SLA Life cycle

SLA has been characterized by the Sun Microsystems Internet Data Center Group (2002)that consists of six core phases[19].The phases are shown in Fig 3 . These phases are as follows :

I. Creation Phase
1. Discover Service Provider: The service providers are located according to consumer‟s requirements
2. Define SLA: It includes definition of services, parties, penalty policies and QoS parameters
3. Establish Agreement: An SLA template is established and filled in by specific agreement, and parties are starting to commit to the agreement

II. Execution Phase
4. Monitor SLA violation: The provider's release performance is measured against to the contract

III.Removal Phase
5. Terminate SLA: SLA terminates due to timeout or any party's contract violation
6. Enforce Penalties for SLA Violation: Whether there is any party violating contract terms, the subsequent penalty clauses are raised and executed.

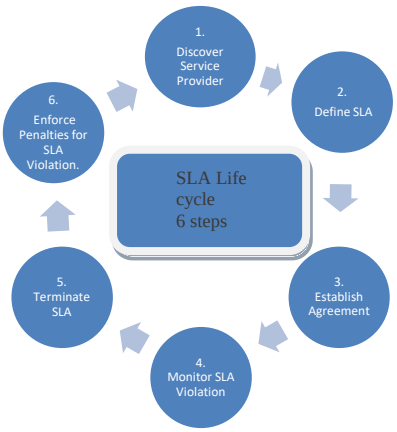

Fig 3: SLA Life Cycle

IV. b. Metrics for SLA

The most common metrics for preparing a SLA template are as follows[20]:

Uptime: It is the time how long a system or a machine is running uninterruptedly. Reliability and availability can be measured by this easily.

Average duration of breakdown: If taking the total summed time for all breakdown and divide it by the total number of occurrences, then getting the average amount of time that the system is down.

Unexpected breakdown time: This is an unanticipated service unavailability, which is not wished at all from a quality service provider. In this period, the system goes down due to system failure.

Downtime: It denotes the complete period of time that the system is unavailable. In other word, it is the system failure of an assured period. This metric can be calculated the reliability, availability.

Mean Time Between Failure: It defines the expected period of time that the service is unavailable during a process.

Mean Time To Repair: It is the time it takes to run a repair after the occurrence of the failure. That is, it is the time spent during the intervention in a given process.

V. CLOUD SLA

A cloud SLA is a documented agreement between the cloud service provider (CSP) and cloud service customer that identifies services and associated quality levels (i.e., cloud service level objectives or SLOs)[21]. The following are significant considerations for service level agreements tailored for the cloud of which to be aware:

1. One of the key difference for cloud SLAs is that the particular organization requesting service assumes possession of the data that it would be stored on the service provider's server.
2. The standards of the services offered by the cloud provider is another parameter which is specified while documenting the SLA that include a brief description of system infrastructure and security standards to be managed by the service provider.
3. To furnish sound rules from the preamble of SLA against the protection of many challenges and uncertainties of the cyber world in the form of cyber attacks and intrusion to avoid the future issues.
4. The areas of coverage should include availability, performance, security/privacy, as well as location, portability and accessibility of the data.
5. It is important to read the cloud provider's SLA in detail. To seek expert opinion of technical persons and compare it with particular SLA is a good managerial practice.
6. It helps the organization for going global.

Cloud computing consists of three service models i.e. SaaS, Paas and IaaS.

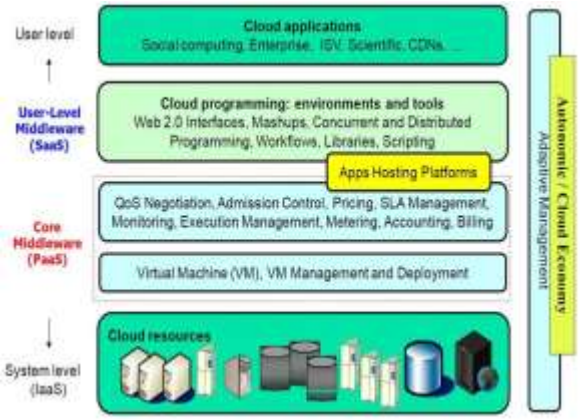

Fig 4 : Layered design of Cloud computing architecture

Fig 4 shows the layered design of Cloud computing architecture. The layers are mainly divided into four. [22]

i. User-Level Applications: This layer is the top layer focuses on software applications such as social computing applications , enterprise applications, scientific applications etc., which will be set up by PaaS providers while hiring resources from IaaS providers.
ii. User-Level Middleware: Cloud programming environments and devices are comprised in this layer as a software services (SaaS) which facilitate the creation of applications and their mapping to various resources via Core Middleware Layer services.
iii. Core Middleware: This layer provides dynamic environment in the structure of platform services(PaaS) which enabling capabilities to application services built using User-Level Middleware. Dynamic SLA management, Execution management, Accounting, Metering, Pricing, Monitoring and Billing are examples of core services in this layer. The commercial examples for this layer are Google App Engine and Aneka.
iv. System Level: This is the bottom layer in which infrastructure services (IaaS) are provided. The physical resources including physical machines such as host machines, servers etc., and virtual machines assemble here. These resources are obviously supervised by higher level virtualization services and toolkits that permit the sharing of their capability among virtual instances of various servers.

V. a. Cloud SLA metrics

The Cloud SLA and QoS metrics are the hottest topic of recent years. But the SLA parameters of today are not sufficient for cloud environment because it is a growing paradigm. So, new SLA samples are necessary to provide elastic procedures for making principles between users and suppliers. The SLA parameters are established by SLA metrics. These metrics are used to calculate various service parameters. The SLA metrics for cloud computing examine the three types of cloud services such as SaaS, PaaS,and IaaS [23].

i. SLA Metrics for IaaS

One of the most well known Cloud Service Provider is Amazon.com, which provides the computing power known as Infrastructure as a Service. The IaaS supplier possesses all resources and is liable for housing, executing and maintaining these resources. The user just pays a usage hire fee for accessing the outsourced services through the Internet. But unfortunately, many clients have the ignorance of the considerable parameters asserted in the hardware side of the SLA. The considerable parameters of the SLA in IaaS are:

- CPU capacity
- Memory size
- Storage
- Boot time
- Scale up
- Scale down
- Maximum number of VMs in one server
- Scale up time
- Scale down time

- Execution time
- Response time
- Availability

ii. SLA Metrics for PaaS

PaaS provides developers with a platform create their own SaaS application. So that they need not to install any equipments for developing their jobs. PaaS provides developers with the necessary tools to create, test, host and maintain the applications they have created. The essential parameters of the SLA metrics for the PaaS are as follows:

- Scalability
- Pas as you go model billing
- Deployment environment
- Number of developers
- Browser
- Security
- Storage

iii. SLA Metrics for SaaS

It is referred to as "software on-demand", SaaS is a software delivery model in which software and data are hosted centrally and acquired using a web browser through the Internet. The SLA metrics for SaaS in terms of cloud services are as follows:

- Reliability
- Customizability
- Usability
- Availability
- Scalability
- Manageability

Table 1: Comparison between SLA life cycle of the existing Cloud Service Providers

Cloud Service Provider	Cloud Service	Service Provider Discovery	Service Availability	Define SLA	Agreement Establishment	Service Violation Monitoring	SLA Violation Credits (Penalties)		SLA Termination
Amazon EC2 [24]	IaaS	Manual discovery	<99.95%	Predefined terms and QoS parameters	SLA document stipulated by the provider	III party monitoring systems can be used under the terms of Amazon's AWS Agreements	Monthly Uptime %	Credits	The service commitment does not apply to any unavailability, suspension or termination or performance issues that are due to the reasons stated in the SLA
							99.0% – < 99.95%	10%	
							<99%	30%	
Google Cloud Storage [25]	PaaS	Manual discovery	>=99.9%	Predefined terms and QoS parameters	SLA document stipulated by the provider	III party monitoring systems can be used under the terms of Google's GCP Agreements	Monthly Uptime %	Credits	The SLA does not apply to few special cases stated in the document
							99.0% – < 99.9%	10%	
							95.0% – < 99.0%	25%	
							<95.0%	50%	

Salesforce [26]	SaaS	Manual discovery	>=99.0%	Predefined terms and QoS parameters	SLA document stipulated by the provider	Provider offers system upgrades and scheduled maintenance and emergency maintenance	Monthly Uptime % is less than the Service Commitment, then issue the Service Credit to users within one billing cycle following the month in which their request is confirmed by the provider.	The Service Commitment does not apply to any unavailability, suspension or termination of the Salesforce SMTP Services, or any other Salesforce SMTP Service performance issue that are due to the reasons stated in the SLA

VI. ENERGY AWARE SLA

Energy aware SLA is an agreement between Cloud providers and customers, which reflects the consent for the cloud provider/Data centre to activate in energy aware manner and concurrently, give an assurance about a certain level of QoS for the customer. Various organizations and even public moves their routine work to the cloud resources now-a-days. Thus, this progress towards the estimation and exposure will impel in the demand for bloom of quantifiable green cloud services. The cloud providers may need to furthermore recommend a novel arrangement of eco-friendly services along with the existing services that they provide. This new set of agreement known as Energy aware SLAs in which the energy used to execute the works is specific or in other way the available energy is to be used competently during the peak load times[27].

Fig 5: Energy Aware SLA

In other words, Energy Aware SLA is an extension of the existing SLA agreements in order to include energy and carbon conscious parameters. While using dynamic VM consolidation along with Energy aware SLA can be achieved low amount of energy consumption with maximized effect on the efficiency and availability of the system. During the increasing demand of the cloud computing results the highest number of energy hungry data centres which is the largest consumers of the energy. During the peak hours more number of VM migrations are occur because to avoid overloading and underloading of servers. Here comes the importance of Energy Aware SLA which is an energy efficient SLA which states assured constraints to the provider asking to hold back some migrations which are not necessary to balance the load of the particular server at peak times. Once the specified time is lapsed the migration which was kept in pause, can be resumed and may continue or start the execution freshly. That decision will certainly reduce the power consumption which in turn reduce the CO_2 emission significantly. As a result of these movement, also improve the Return of Investment of the cloud providers and in turn it will favorably affect the consumers while reducing their service charges by the providers.

VII. PENALTIES FOR SLA VIOLATION

IaaS SLAs are completely architectured as Network services, hosting and data center outsourcing SLA. S LA metrics are generally calculated on monthly basis[28].If SLA violation occurs service fee of the user is credited on the basis of the time period multiplied by the affected service's cost. Longer single violations, longer cumulative violations or repeated violations may carry disproportionately higher penalties.The penalty for an SLA violation is usually capped at 100% of one month's service fees and not based on any SLA metrics such as downtime which may be causes for revenue lost.

VIII. CONCLUSION

We have presented a detailed survey of Service Level Agreement in Cloud computing paradigm, which is the integral part of cloud environment. While organization employs cloud services, the duties of both the cloud consumer and the service provider must be obviously characterized in a Service Level Agreement. An SLA characterizes how the cloud consumer will use

the services and how the cloud provider will convey them. It is vital that the consumer of cloud services completely recognize all the requisites of the provider's SLA, and that the consumer consider the requirements of their organization before signing any agreement. In this survey, we have discussed the requisites of cloud SLA, metrics for SLA in clouds, and finally providing a comparison among the present major cloud service providers SLAs.

In addition to existing Cloud SLA, we are investigating, the Energy Aware SLA, an extension of the existing SLA agreements in order to include energy and carbon conscious parameters. The provider asking to hold back some migrations which are not necessary to balance the load of the particular server at peak times with the support of assured constraints of the agreement. So the Energy Aware SLA plays a considerable role in green cloud computing, as a result by making the Coud SLA green.

Though this detailed study, we reach a conclusion that cloud is lack of standards. This is because cloud is rapid growing model. So a cloud computing is facing some open challenges like scalability, dynamic environmental changes, heterogeneity of data centres, SLA management automation, Energy consumption of data centres etc. Present SLA metrics for cloud environment is insufficient. For future work, the efforts will be made to contribute for standardizing SLA models for clouds by proposing advanced metrics for both SLA monitoring and standardized SLA monitoring structure.

IX. ACKNOWLEDGMENTS

The authors would like to acknowledge and thank all people who help them in different ways to fulfill their research work.

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