

ADOPTION & OPTIMIZATION OF CLOUD MANAGEMENT: CURRENT ISSUES AND FUTURE DIRECTIONS

Dr. Manish Saraswat¹, Dr. Mukesh Choudhary², Ajay Prashar³, Ajay Kumar⁴, Dr. Promila Bahadur⁵

¹Associate professor, Faculty of Science & Technology, ICFAI University, Baddi, Himachal Pradesh.

²Associate professor, Geetanjali Institute of Technical Studies, Udaipur, Rajasthan.

³Assistant professor, Faculty of Science & Technology, ICFAI University, Baddi, Himachal Pradesh.

⁴M.Tech, Computer Science Engineering.

⁵Associate Professor, Department of Computer Science and Engineering, IET Lucknow, Uttar Pradesh.

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Abstract

Computing in the cloud is the current technological paradigm that holds the greatest promise of bringing about a fundamental shift in the way information technology operations are carried out. Cloud computing has an impact on virtually every field of human endeavour that is currently known. Applications that are simple to operate and can be accessed online at any time and from any location are made available by the cloud. The use of cloud computing also makes it possible for businesses and organisations to develop and deploy their very own applications. In addition to this, the cloud provides scalable storage facilities, which also incorporate processing capabilities. For the purposes of storage and computing, the cloud makes use of many different data centres, each of which contains physical machines or servers. These data centres have a significant impact on the amount of energy used. The amount of electricity that is being used is quite high, and it is only going to keep rising. Because of the significant amount of energy required by the servers and the cooling equipment, it is essential that this resource be effectively managed. The research was carried out using some theoretical concepts and existing cloud management optimization literature as a basis for the investigation. This research investigates the current challenges and potential future developments in cloud management adoption and optimization. This conclusion will provide insight that can be used for further work in the adoption and optimization of cloud management.

Keywords: Cloud Computing, Optimisation, Adoption, Issues

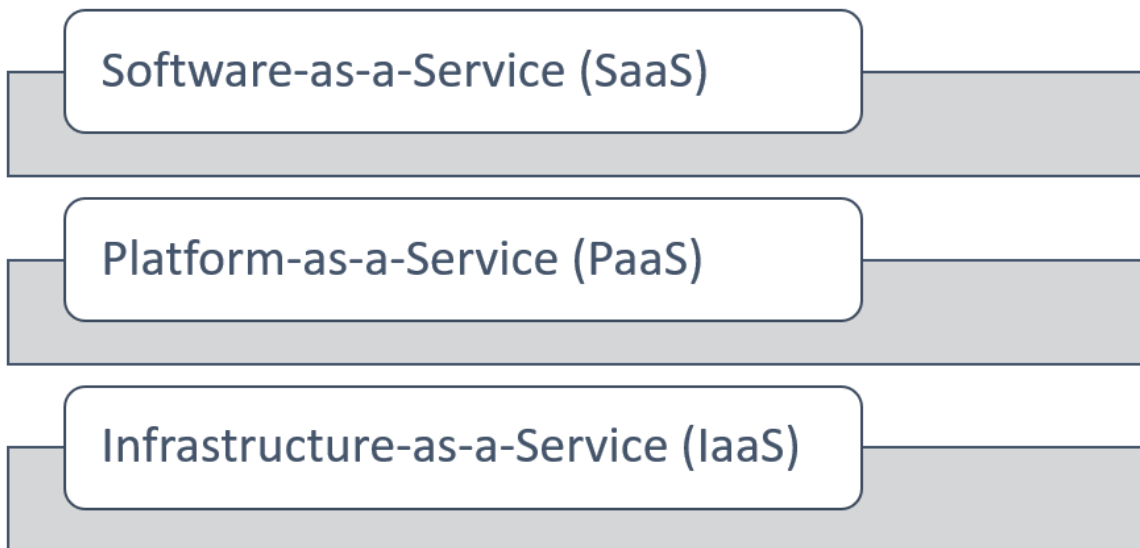
Introduction

The term "cloud computing" refers to computing services that are accessible to users worldwide via the internet. The term "cloud computing" refers to a style of computing in which resources are provided as a service over the internet in a way that is both dynamically scalable and frequently virtualized.

The term "cloud computing" refers to a model that "enables ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources such as networks, servers, storage, applications, and services" that can be rapidly provisioned and planned to release with minimal management effort or service provider interaction (P. Mell, T. Grance, 2011).

This type of network access is made possible by "cloud computing." Computing in the cloud is undergoing rapid change while simultaneously having a significant impact in a variety of spheres of life. New technological advancements are being made, and at the same time, an increasing number of businesses are moving their operations to the cloud. Computing in the cloud confers a number of advantages on establishments of all sizes, including corporations and small businesses. Utilizing the infrastructure that is available through cloud computing can help the vast majority of businesses cut their costs.

The services of Cloud is categorized in 03 primary ways



Benefits of Cloud Computing

1. Scalability: It's possible that an organization's internal information technology systems aren't scalable enough to meet peak demand for workloads. If this is the case, the business will have to pay for and keep excess capacity. Customers can instantly expand or reduce their both software and hardware capacity needs to meet business requirements when they use cloud computing. This enables customers to better meet their needs.

2. Pay-Per-Use: This model allows customers to avoid making large upfront investments in data centres and servers before it is known how those assets will be put to use. Instead, customers pay only when they use computing resources, and they pay only for the amount of those resources that they use.

3. Increased Speed and Agility: In a cloud computing environment, new information technology resources can be made available with just a few clicks of the mouse. Customers, as a result, have the ability to cut the amount of time it takes to make those resources available to developers from weeks to mere minutes.

4. Outsourcing: Customers can avoid racking, stacking, and powering their servers, in addition to avoiding the ongoing maintenance of their data centres by using cloud computing, which enables them to avoid cloud computing.

5. Global Reach: Applications can be deployed in a number of different regions all over the world with only a few clicks of the mouse. This, in turn, makes it possible for applications to have lower latency and offers end users a more satisfying experience.

Also, many companies are moving to hybrid and multi-cloud architectures to avoid vendor lock-in and keep the option to host sensitive workloads in a more secure environment.

The following are explanations of the terms hybrid cloud and multi-cloud:

- **Hybrid Cloud:** the deployment of applications in a mixture of different environments, such as “on-premises, private cloud, and public cloud”.
- **Multi-Cloud :** refers to the deployment of applications across multiple public cloud service providers as opposed to utilising just one public cloud service provider exclusively.

Cloud Management

Cloud management is a term that is typically used to refer to the software applications & available platforms that are helpful for controlling & monitoring to manage operations, managing services as well as data that are stored in the cloud [11]. Tools and technologies for cloud management guarantee the highest possible level of performance for cloud services & cloud resources. Cloud management entails a variety of tasks, including the monitoring of performance, as well as concerns regarding security and compliance [11]. The term "cloud optimization" refers to the process of using the cloud's computing resources and other infrastructure in a manner that is both more efficient and effective. By relieving users of the upfront costs and ongoing maintenance of on-premises infrastructure, cloud computing paves the way for businesses to launch on a smaller scale and expand over time. This ensures that the business will have the best possible development. Users of cloud services have the ability to estimate their future costs of usage thanks to flexible pricing models. The pay-per-use payment model is implemented for the utilisation of the network, storage, and processing resources. Users are granted access to resources, can make use of those resources for as long as they see fit, and must then give up access to those resources [11]. The use of cloud computing is expected to result in a reduction of approximately 5% -7% points in the amount of money spent on the electricity & also spending on network bandwidth, software requirements , operations & hardware requirements [12]. This will be accomplished by ensuring that large organisations have accurate and multiplexing of their current resources and logging of their current usage. Cloud computing helps reduce energy consumption by removing unnecessary processes and enabling more effective resource management by cloud service providers (CSPs).

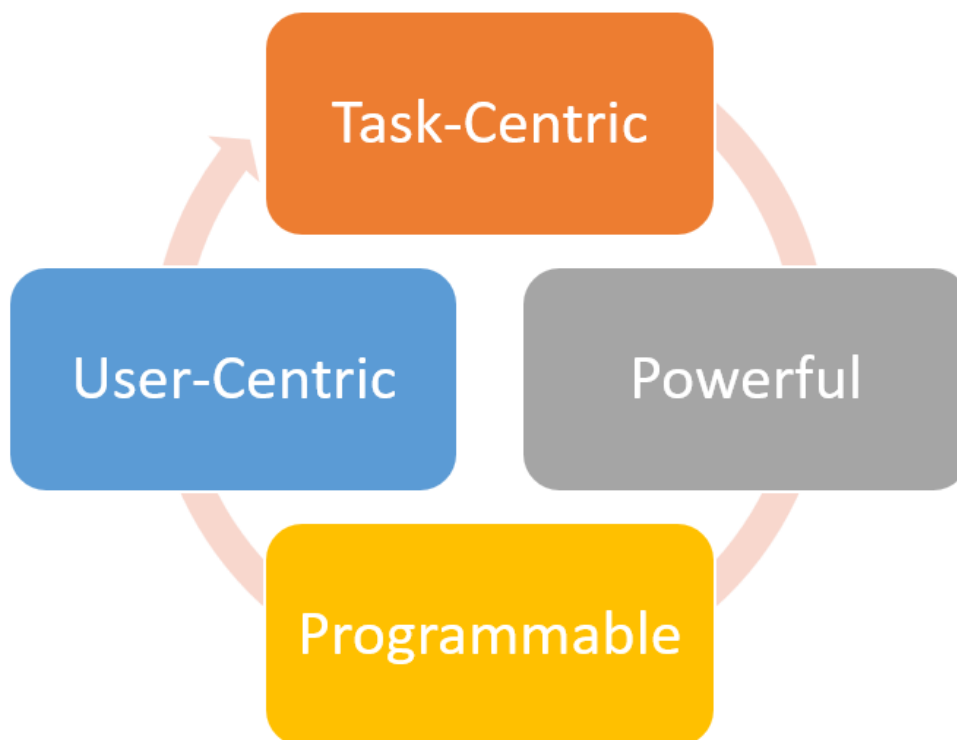
Largest Market Share of cloud service providers

The three cloud service providers which are having largest market share are “*Amazon Web Services (AWS)*”, “*Microsoft Azure*” & “*Google Cloud Platform (GCP)*”. Collectively, these three companies account for more than 65% of all money spent on cloud infrastructure services. In the table below highlights the top ten service providers deals in cloud that are ranked according to their market share, with AWS' market share listed as 34%, “Microsoft Azure's” market share listed as 22% & “Google Cloud's” market share listed as 9.5%.

#	Cloud Service Provider	Market Share
1	Amazon Web Services (AWS)	34%
2	Microsoft Azure	22%
3	Google Cloud Platform (GCP)	9.5%
4	Alibaba Cloud	6%
5	Oracle Cloud	2%
6	IBM Cloud (Kyndryl)	2%
7	Tencent Cloud	2%
8	OVHcloud	<1%
9	DigitalOcean	<1%
10	Linode (Akamai)	<1%

Cloud Computing & It's Properties

Figure : properties of Cloud Computing



Cloud Optimization & Management

A. Management and Optimization Objectives

Cloud management is the process of assuming and carrying out administrative responsibilities related to cloud infrastructure [4]. Users can exert agency over the cloud's elasticity and changeability with the help of a well-executed management plan. Some objectives of management and optimization are as follows [4].

With the advent of cloud management, end-users now have the option to handle their own requests. Therefore, the traditional method of providing IT resources is no longer necessary. Users have access to a wide variety of cloud services and can keep tabs on running jobs, create brand-new ones, track resource consumption, and fine-tune their resource allocation costs. Budgetary allocations can be monitored and adjusted as needed through the reporting capabilities in order to lower operating costs.

The second benefit is that workflow can be automated thanks to cloud management. Businesses can translate their strategies and policies into the actions and procedures needed to provision as well as manage cloud instances with little to no human intervention using automation. Workflow automation helps businesses meet reporting and compliance standards, in addition to being useful in developing, deploying, and fine-tuning labor-intensive cloud processes. When an employee tries to move data from a private cloud to the public cloud, potentially in violation of the security of company & compliance policies as well as regulations, cloud management tools can notify an administrator.

Thirdly, the analysis of workload is possible thanks to cloud management. Using a private cloud, a company can assess the efficiency of its cloud infrastructure and provide fundamental services like load balancing and capacity planning. Measurements of server downtime help ensure SLA compliance in public cloud environments. Incorporating metrics allows businesses to determine whether or not to use cloud service providers and, if so, whether to migrate workloads from public to private clouds. In order to meet the demands of their services, public cloud providers use sophisticated tools.

B. Strategies for Optimizing the Cloud

Cloud management and optimization practises centre on maximising the effectiveness of the cloud's underlying infrastructure to support business operations. Organizational management teams are beginning to recognise the need for cloud optimization [2] due to the wide variety of services that cloud computing consistently delivers as part of the IT infrastructure of an organisation. Cloud service adoption alone is not enough to guarantee peak performance and productivity, as companies have found out. This is because cloud services necessitate meticulous resource tracking and analysis.

Few major cloud optimization strategies are discussed below [2]:

- 1) Governance cloud strategies & cloud optimization are closely related concepts that go hand in hand. A company's cloud governance strategy will determine the methodology by which it will evaluate and maintain its cloud solution in accordance with the guidelines that have already been established. Cloud governance has the potential to significantly cut down on inefficient instances of cloud usage, thereby ensuring that resources are used in a responsible manner.
- 2) A company needs a system to track who is using its cloud services and where they are located. This method must be able to provide this information. This contributes to ensuring that the cloud services continue to operate at their full potential.
- 3) Numerous workstations are used in cloud platforms, and each one is active only during business hours. Dynamic uptime, scaling, and scheduling allow for more flexibility in how these systems are used. The back-end systems are frequently idle, with the exception of running batch functions on a periodic basis. Therefore, systems should

be analysed and organised according to the uptime requirements that they have, such as being available 24/7 or only during the week, in addition to having a regular batch function. It is possible to scale the system according to load or any other metrics that are determined to guarantee that it will fulfil requirements. The level of system availability ought to be automatically determined by categorization.

4) Using contracts for purchase, large discounts are offered by the major cloud service providers to customers who meet certain purchase quotas over a specified time period. It is possible to reduce expenses and increase ROI by employing one of the numerous spending models available. Thus, determining uptime schedules is essential for employing the right model.

5) The majority of cloud infrastructures begin as lift and shift projects, in which the pre-existing on-premise infrastructure is mapped to the cloud in its current state. This strategy has the potential to produce an oversized and ineffective system. As a result, each instance of the system and feature ought to have their size determined in accordance with the actual performance requirements. There are significant savings to be had by using reserved instances and powering down unused instances.

6) One must pick an instance that fits the basic need of a company. On-demand sizing adjustments are also possible if continued use and monitoring reveals a need to modify the requirements.

7) The cloud computing model is dynamic and can change to meet the needs of the users. The auto scale feature is a fundamental and essential part of cloud computing, allowing users to define their minimum and maximum instance pools and other basic scaling metrics like CPU utilisation rate.

8) Metrics and rules, such as a CPU utilisation rate of less than 10%, should be used to terminate unused capacity. Snapshots of the instance's image and volumes can be taken automatically with the start/stop option, which is useful during a recovery operation. Reserved Capacity: An accurate estimation of the capacity for both planning and demand can help improve operational efficacy. Utilizing reserved and spot instances' capacities results in lower rates of payment.

9) Resources It is possible to lower costs for computing resources by using spot instances or by deploying in a geographical region that has lower costs overall, depending on the services that are available. It is absolutely necessary to transfer data from expensive disc volumes to storage in the cloud. Using an archive service such as 'Glacier' can help reduce storage costs by a significant amount.

10) Choosing and putting into action tools that create openness and aid in getting to proper resource utilisation is crucial for any business. It's also worth noting that this is an essential prerequisite to moving forward.

C. Architecture for Optimization

An optimization architecture for the cloud is presented in reference [2]. The architecture that has been proposed is organised in layers. There are three optimization layers, each of which is based on one of the three service models that make up the architecture of cloud computing: “*SaaS, PaaS, and IaaS*”. It is in the best interest of each layer to either maximise profits or increase user engagement and satisfaction, so optimization of each layer is a priority. As a result of the increased level of abstraction introduced by virtualization and the SaaS model, the variety and number of techniques used to gauge optimization (via sensors) or propel optimization (via actuators) have been severely constrained.

D. Simulation of Optimization

Optimization in the cloud is a continuous process that begins with new application deployment, changes to the workload's characteristics, fixes to hardware and software, and routine maintenance.

a. The First Scenario: A Sudden Increase in Demand for an Application The application needs to determine whether or not it requires additional capacity or improved load balancing, and it can do this by streamlining its

utilisation in the new environment. At the same time, the PaaS layer is accountable for finding the best option that will either provide it with resources that it already possesses or request from the IaaS layer, which must deploy and allocate additional VMs in an efficient manner.

b. The Second Scenario: The availability of resources across all layers is immediately and drastically reduced whenever a node fails. The IaaS must ascertain the cause of the failure and then take measures to restore service by deploying new VMs and, if necessary, making a copy of the data in its current state. The “PaaS” layer then acts in response by possibly deploying a replica container within these VMs, and finally the “SaaS” layer rolls out a copy of the app.

E. Cloud Load Balancing

CLB, or cloud load balancing, is an integral part of cloud resource management and optimization. This entails actions like allocating processing resources and dividing up work to be done. This has direct relevance to the question of how jobs are dispersed throughout a given region. By facilitating the pooling of resources for use by a number of services or clients, CLB gives businesses the ability to precisely manage applications.

Issues in Cloud Computing Adoption

Before adopting cloud computing clarify below issues:-

According to Edwards (2009), an enterprise user of cloud computing should address seven security concerns with cloud computing providers prior to adoption.

This pertains to the User Interface and Access. Inquire about the providers' policies regarding the hiring, supervision, and control of privileged administrators and their access to sensitive data.

Major corporations need to set and stick to their own standards for hiring cloud infrastructure operators.

Adherence to rules and laws. Verify that the service you choose is open to third-party audits and security certifications.

Data storage. Organizations should insist that their cloud service provider adhere to the data privacy laws of the jurisdictions in which their data will be stored and processed.

Separation of Concerns when Handling Personal Information. Find out what measures are taken to keep your data separate, and demand proof that adequate encryption is in place.

Proof of Disaster Recovery Plan. Find out if your provider can fully restore your data and service in the event of a disaster, and how long it will take, so you can prepare accordingly.

Backing up Data and Restoring Systems in the Event of a Disaster. Confirm the provider's track record with similar tasks, and press for a written guarantee of service for specialised investigations like those required during pre-litigation reconnaissance. Make sure you have evidence before assuming that it can do that.

Strength for the Future. Determine if your data can be easily imported into a new application by asking potential service provider how you would get your data back in the event of their failure or acquisition.

Conclusion

The technology behind and applications for cloud computing are both undergoing development. Cloud computing not only offers pre-built applications but also gives users the ability to deploy their own software. Users of cloud computing have access to a vast infrastructure that provides both storage and computing resources. If cloud

providers and users want to experience the greatest level of satisfaction from their cloud activities, management and optimization are absolutely necessary. Management and optimization of cloud resources can be accomplished with the help of various strategies, technological tools, and operational procedures. Cloud computing is the result of the integration of several established and developing technologies. Though businesses may save money by using cloud computing, substantial security risks exist. Businesses that are considering adopting cloud computing as a means to reduce expenses and boost profits should first conduct a thorough assessment of the security risks associated with the technology. One of cloud computing's greatest strengths is improved centralised risk management for handling sensitive data. Cloud computing is a relatively new phenomenon that has the potential to drastically alter the way in which people access and use the Internet, but it is important to proceed with caution. New technologies are constantly being developed, and many of them have the potential to make people's lives simpler and more convenient in various ways. When utilising these technologies, however, one must exercise extreme caution due to the risks and difficulties associated with security.

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