

A Comprehensive Survey on Cloud Computing

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Abstract

Cloud computing is a key technological development in the information technology industry. It is one of the best techniques for managing and allocating a lot of information and resources across the entire internet. Technically speaking, cloud computing refers to accessing IT infrastructure through a computer network without having to install anything on your personal computer. Businesses can modify their resource levels to match their operational needs by utilizing cloud computing. Organizations and corporations can cut infrastructural costs with the use of cloud computing. Organizations can test their applications more quickly, with better management, and with less upkeep. The IT team can adapt resources to changing and erratic requirements thanks to cloud computing. There is proof that cloud computing has a role in everyday life thanks to various applications in various contexts. This essay will cover every aspect of cloud computing, including its architecture, traits, types, service models, advantages, and challenges.

Keywords: Cloud computing, Architecture, characteristics, Types, Service model, Benefits and Challenges

INTRODUCTION

The development of cloud computing has significantly changed how the IT sector functions today. Cloud computing makes it possible to investigate better IT services with lower expenses and less investment. The popularity of software as a service has increased because of cloud computing's impact on how IT hardware is developed and procured. It is an internet-based technology that gives users access to server-stored data as a service whenever they want.

Customers only pay for the service they use because it is a pay-as-you-go service. Cloud computing is as a computing model in which massively scalable IT-enabled capabilities are offered as a service to numerous customers. It is the use of internet-based computer technology for a variety of services (as storage capacity, processing power, business applications, or components). [1].

It is a set of network-enabled services that offer scalable, guaranteed, typically customized, relatively affordable services in an easy-to-use manner. [2]. Cloud computing is defined as a computing approach in which enormously scalable IT-related capabilities are delivered as a service through the internet to various

External consumers.[3]. This is an information technology service paradigm in which hardware and software are given to consumers on demand across a network without the use of a device or location. [4]. The National Institute of Standards and Technology defines cloud computing as a model for allowing ubiquitous, convenient, a shared pool of customized computing resources, and services that can be swiftly supplied and deployed with minimum administrative work or service contact. [5]. Cloud computing are of four types namely private cloud, public cloud, community cloud, and hybrid cloud..

There are three popular service models in cloud computing. They are as follows:.. Platform as a service, infrastructure as a service, and software as a service. These are all examples of cloud computing. There are some challenges to be considered in choosing a solution, they also present tremendous chances with significant rewards. This research will present an overview of cloud computing architecture, features, and service models, as well as discuss their advantages and challenges.

HISTORY, LITERATURE REVIEW AND METHODOLOGY ON CLOUD COMPUTING

History of cloud computing Cloud computing was developed by John McCarthy in 1960.. "The use of computers, as a subject of research may be arranged as a public utility eventually." According to Parkhill in The computer utility challenges [6]. The name "Cloud" computing was introduced in telecommunication industry as a virtual private network. There was wastage of Bandwidth using point-point data lines. Network utilization was balanced using virtual private network.. Servers and network infrastructure are now included. Cloud computing has been widely used by industry Participants.

Amazon introduced Amazon web services and this has been of great help to their business..

Furthermore, Google and IBM have both launched cloud computing research. Eucalyptus was the first open-source platform for private cloud deployment.

Literature review on cloud computing

Cloud computing, also known as the internet, was first proposed by American Psychologist and Computer scientist Lickliter J.C in 1960 with the aim of connecting information, data, and people together globally. As the years go on, the evolution of cloud computing started around 2006 when Amazon introduced "Amazon web services (AWS)" as an elastic cloud computing. In 2008, Google introduced the "Beta" version of search engine. In 2012, Oracle rolled out Oracle cloud computing. Since the Introduction of cloud computing by many organizations, literature on the application, significance and management of cloud computing have been published over the years. For instance, [7] focused on the adoption of internet computing in the information technology industry in some developing countries. The study focused on how the major information management industry in Pakistan used a constructive questionnaire to gather information about the employees via email to validate the prototype). [8] recommended that, to encourage better performance to increase the effectiveness and enhancement of data storage, the network providers must perform some new tasks to increase the storage capacity of online data.

[9] evaluated how much larger memory space was available in 2018 by using cloud housed 5347EB to save data. This spacious memory allowed organizations to store, examine, and acquire valuable data on customers' information, interests, and reactions. [10] proposed an internet computing device that allows small companies to save and distribute data. In recent years, there has been an upsurge in how hackers have breached cloud computing security by targeting computers to steal valuable data and damage data stored using ransomware. [11] Emphasizing the high-security level of cloud computing firms. Hackers have acquired substantial smoothness in their exertion; this has compelled organizations to spend quality time and effort to develop an approach to keep data safe and detect malware. These continuous attacks alert security experts to enlarge their security and response time. [8] To carry out this, firms must hire security experts who are ready to keep data safe and sensitive information away from hackers.

Likewise, the research conducted by [12] estimated the use of the 5G network launched by the internet service provider to increase the quality of services on the internet. The launching of the 5G network in 2019 with a better speed for customers to access and load customers information faster than the previous

networks, also enabling people and organizations to send and receive information in real-time. Furthermore, due to the widespread availability and improvement of smartphones, mobile cloud computing must be managed in terms of supporting apps and processing capacity. According to [13], mobile cloud computing is the combination of mobile and cloud computing to provide mobile devices with processing power, memory, and storage (2013). On the other hand, [14] referred to mobile cloud computing in another study as mobile cloud computing. [13] focused on its applications, security, and uniform standard that can improve the hardware and battery life of mobile devices. [15] highlighted the importance of mobile cloud computing on social network services like video generation, gaming, and image management. This study pointed at two mobile cloud computing models- (2009), and the importance of intelligent access strategies was accentuated by [16] in their journal on cloud computing in bank industry, it was found that, financial institutions are embracing new technologies to gain a competitive advantage in the banking industry and about 41% of the total 391 sampled commercial banks and other financial institutions have incorporated cloud computing and others have clearly stated and developed plans to do so. The study pointed out how cloud computing can interact with the newly spring-up technologies to ensure mutual advantage, increase cost benefits, control operational risks involved in the integration of cloud computing with bank sector activities, and maximize profit efficiency which was done by the launching of "internet plus" introduced by the government of China to conduct a research on the largest banking system, the Chinese banking sector in November 2012, in which cloud computing played a crucial role as a part of national strategies. Another related research conducted on the dynamic workflow scheduling algorithm in cloud computing was researched by [18] The study focused on the use of cloud computing resources to perform workflow tasks, the study designed a problem scheduling dynamic workflow as a dynamic multi- objective optimization problem (DMOP), the source of dynamism is both resource failure and the possibility of modifying the number of objectives during the period. The study proposed a predictive-based dynamic multi-objective evolutionary algorithm known as the NN-DNSGA-ii algorithm that outperformed the other choices by merging an artificial neural network with the DNSGA-ii.

In machine learning cloud computing, the development of a machine learning approach is generally employed. Computer vision, pattern recognition, and bioinformatics are all used in various businesses [19] The development of machine learning

techniques has benefited large-scale computer systems [25]. [29] outlines Google's efforts to correct electricity use, maximize profit efficiency, and increase efficiency. Despite the previous works on machine learning algorithms in cloud computing there still existed uncertainty in the integration of machine learning into cloud computing management, as a result

[26] presented a model to reinforce data usage from a thorough analysis of the two most major data controls resource management research activities to consolidate previous works based on objective model.

Using cloud computing to develop knowledge ambidexterity [20] Using a longitudinal case study, they examined how cloud computing has contributed to the development of knowledge ambidexterity (K-AMB) by adopting a cross-theory technique to assess the link that exists between information management principles and ambidexterity. Prior studies revealed that with the use of digital technology, knowledge ambidexterity in efficiency might be obtained [27], The study examined a framework connection that exists between cloud computing and knowledge ambidexterity, and KM actions from a factual perspective to investigate how SMEs allow knowledge ambidexterity innovation capabilities and

stated the major.

In the research on Securing authentication scheme in cloud computing with a glimpse of an artificial neural network, [30], focused on the survey of the cloud security issues and authentication scheme, and offer a glimpse of an artificial neural network applied to the cloud security environment to provide users access management with proper cloud security to deny access from unauthorized person to access confidential data. To achieve cloud security. The study set out security goals to ensure data security that includes authentication, confidentiality, integrity, and accountability. [21] discussed the development of block cipher using a neural network to achieve the elementary. [21] estimated a Hopfield neutral network and password authentication, this was achieved by a pattern recall approach in which the data array of encrypted passwords is hoarded on the server, and the unplanned pattern recall approach used sparse coding algorithms. Therefore, based on the artificial neural network new cryptography is essential.

In a study regarding job scheduling in cloud computing using a hybrid moth search algorithm, [28] developed a similar algorithm with the aim of solving the problem associated with cloud task scheduling to minimize the required time to program a list of jobs on different virtual machines. [23] performed a differential evaluation using two techniques known as photo taxis and levy flight possessed consideration and squeezing ability to improve the already existing moth search algorithm (MSA), (DE), since the performance of the approach relies on the improvement on the improved MSA to carry-out task scheduling in cloud computing. Cloud computing in the management of education institutions analyzed the role of cloud computing in the management of educational institutions and how the adoption can help to reduce information technology costs while also achieving better adaptability and portability. put forward a well- detailed introduction to the practice of cloud computing in higher institutions. [24] evaluate the initial position of the institution management and how it will gear the incorporation into cloud computing that is more reliable and efficient. They analyzed the structural technologies and interconnected components; they also initiated new services that will take in place of many types of computational resources presently used. In that view, they also considered that grid computing will be engaged in a pivot role in illustrating how cloud services will be offered. They also developed a model that will meet the needs of the

students, procurement, finance, and accounting department, etc. These services are controlled by the cloud network provider to users every time they demand.

Methodology

According to [34], the research technique approaches and methods form the research methodology used in collecting information regarding different parts of a problem. The method adopted is descriptive method. Materials for the writing was sourced through Google scholar,

Scopus. We came across different views about cloud computing by different authors. Different authors had their own definition of cloud computing. The key thing we discovered about cloud computing is that you pay as you use the service.

CLOUD COMPUTING ARCHITECTURE

The services delivered by cloud computing are classified into three types. The front and back ends [31]. The front end and back end are connected through a network, which is usually the network. The front end of a system is seen by the client (user), but the back end is the system cloud. On the back end are the client's computers, servers, and data storage. A centralized server oversees system management, traffic monitoring, and client requests. It employs specialized software known as protocols and follows predetermined standards. The following are the levels and services of cloud computing architecture. The client, the application, the platform, the infrastructure, and the server [31]. A cloud customer is a collection of computer hardware and software that leverages cloud computing to offer applications designed specifically to deliver cloud services [31]. The three forms of cloud computing are list Cloud architectures are used by a variety of applications, including web-based back-office bulk processing systems. These are a few examples.

- Processing pipelines for document processing to OCR: This converts millions of pages and pictures into searchable raw text and converts thousands of documents from Microsoft Word to PDF.
- Pipelines for image processing that may encrypt MPEG or AVI movies. developing an index for web crawlers Millions of records are searched through data mining.
- System for batch processing: this type of system is a Back-office application that can be seen in the banking, insurance, and retail industries. log analysis is used to generate daily and weekly reports.
- Night builds perform concurrent automated builds of the source code repository each night. Deployment testing and automated unit testing carry out functional, quality, and load testing on many configurations.
- Websites This includes websites that scale automatically during the day but are redundant at night. Instant websites are websites designed specifically for conferences or events. Seasonal websites operate according to the seasons, such as during the holidays or tax season. Model for cloud computing services

In addition to the five qualities, the following three service models are used to categorize cloud services.

Infrastructure-as-a-service (IaaS)

Cloud users directly make use of the necessary computer resources and information technology infrastructure, such as processing, storage, networks,

and other, that are made available by the cloud. In the (IaaS) cloud, virtualization is frequently used to combine and separate physical resources as needed to meet the variable resource demands of cloud users. The core virtualization strategy involves creating distinct virtual machines (VM) that are isolated from both the underlying hardware and other VMs. Since numerous instances (from separate cloud users) can operate on a single application thanks to the multi-tenancy paradigm, the software architecture of the application is altered. Contrary to that model, this tactic is different. Google, App Engine, Microsoft Azure, Java, and developer tools are a few examples of infrastructure as a service.

A. Platform as a service (PaaS)

A platform for development known as "platform as a service" enables users of the cloud to build cloud services and apps by supporting the whole "software lifecycle." In contrast to SaaS, which only hosts finished cloud applications, this provides a development platform that hosts both finished and in-progress cloud applications. As a result, PaaS offers development infrastructure such as configuration management, tools, programming environments, and other components in addition to a hosting environment. Microsoft Azure, Google App Engine, developer tools, and Java are a few examples of PaaS.

B. Software as a service (SaaS)

A variety of customers with access to networks can access the program that cloud customers publish in a hosting environment (such as web browsers). To achieve economies of scale and optimization in terms of speed, availability, disaster recovery, maintenance, and security, users of the applications of various cloud consumers are grouped on the SaaS cloud in a single logical environment.

The cloud infrastructure commonly employs a multi-tenancy system architecture and is not under the user's control. Examples include Salesforce, Google Docs, and Google.

C. Data storage as service (DaaS)

Virtualized storage that is made available on demand is now a separate cloud service called data storage service. Excellent data storage service, as a unique IaaS type. This is due to the fact that expensive upfront expenses for on-premises enterprise database systems are sometimes associated with dedicated servers, software licenses, post-delivery services, and internal IT maintenance. Customers can use DaaS to pay only for the services they use rather than obtaining a site license for the entire database. Along with more traditional storage interfaces like file systems and relational database management systems (RDBMS), which are frequently too big, too slow, and quite expensive, some data storage service providers also offer table-style abstractions that store and retrieve a sizable amount of data in a highly compressed timescale.

2. CHARACTERISTICS OF CLOUD COMPUTING

According to the National Institute of Standards and Technology [5], cloud computing has five features that make it suitable for information technology applications and services.

A. On-demand self service

On-demand self-service: Cloud services such as server time, storage, web applications, computing power, and networks may be delivered automatically to consumers as needed, eliminating the need for human interaction.

B. Resource pooling

Cloud providers pool their computing resources together to accommodate multiple customers. This is accomplished either through virtualization, which uses virtual machines to replicate physical hardware or through "multi-tenancy," which allows multiple users of the same resources. This is made possible by having various physical and virtual resources that are dynamically assigned and reassigned in response to changing consumer demand (Mell, 2009) [32].

The concept of a pool-oriented computing paradigm is inspired by economies of scale and resource specialization. Physical computing resources have resulted in this community paradigm. It suggests that the customers are unaware of the available resources. Consumers are oblivious to the origins, location, and physical composition of the resources they utilize.

Customers are unable to identify the place in certain clouds where their data is supposed to be kept. This enables resource pooling without exposing the resource provider's management structure and allows for fully flexible resource offering to clients.

C. Broad network access

Numerous clients (applications) that access the required computer resources through a network, mostly the internet, employ a range of platforms, including laptops, microcomputers, and mobile phones, all of which are present at the consumer's end. The benefits of cloud computing can be expanded thanks to broadband network connectivity.

D. Rapid elasticity

Numerous clients (applications) that access the required computer resources through a network, mostly the internet, employ a range of platforms, including laptops, microcomputers, and mobile phones, all of which are present at the consumer's end. The benefits of cloud computing can be expanded thanks to broadband network connectivity. Numerous clients (applications) that access the required computer resources through a network, mostly the internet, employ a range of platforms, including laptops, microcomputers, and mobile phones, all of which are present at the consumer's end. The benefits of cloud computing can be expanded thanks to broadband network connectivity.

E. Measured service

In a cloud environment, multiple users may share computer resources (multi-tenancy), but the cloud infrastructure may make use of tools to monitor how each user is using these resources. The cloud computing metering methods enable for the individual invoicing of numerous cloud users.

3. CLOUD COMPUTING DEPLOYMENT TYPE

There are basically three types of cloud, private cloud, public cloud, and hybrid cloud. These are classified based on the size of the network, security, and the number of users

A. Private cloud

A private cloud is developed and maintained especially for a single firm, but the administrator also allows outside companies to use the cloud. The private cloud allows for on-site or off-site activities. The private cloud provides good cost management, cost control, privacy, and energy efficiency. Private clouds have a limited capacity and are restricted to a certain area.

B. Public cloud

This is a cloud computing service that the public or anyone can use or purchase. It is provided by a third party over the public internet. Customers using this type of service only pay for the services they really utilize. If they have internet availability, every employee of the organization can use the programme from any office or branch using whatever device they choose.

C. Community cloud

Several institutions or organizations with similar objectives host a community cloud. It is frequently used in universities for both teaching and research. Businesses have the option of managing the cloud system themselves, either on- or off-site, or by outsourcing with a different organization to handle daily system operations.

D. Hybrid cloud

Different cloud systems comprise a hybrid cloud. It typically consists of two or more distinct clouds. For instance, a company may opt to use the public cloud for daily operations while storing sensitive data in their own data center. Using a hybrid cloud could have several advantages. Large and well-known organizations are more likely to make significant investments in the infrastructure needed to offer resources internally. Safety is an additional factor.

4. BENEFITS AND CHALLENGES OF CLOUD COMPUTING

There are many benefits cloud computing offers to its users that encourages them to adopt it. Cost reduction, increased productivity and easy scalability are the main benefits of adopting cloud computing.

A. Cost reduction

The usage of the software as a service enables commercial organizations to pay less for information technology resources, improving both the performance and profitability of their operations. Customers are required to pay according to their usage. Customers that need an application for a brief period, pay the application's license fees. The cost of purchasing unneeded resources and apps is reduced by the cloud-based solution. Users may benefit from continual upgrades and maintenance without the costs and time constraints associated with it in this case because the service provider owns and hosts. Clients who use cloud computing technology are not required to create data backups. For the storage of data, cloud service providers use several redundant locations. This is acceptable for business continuity and incident recovery. Business enterprises are not concerned about data loss and recovery from backups [33].

B. Increased productivity

Due to the rapid growth of technology, consumers are becoming more demanding. They need the products sooner and in reduced hours. To use information technology solutions like collaborative online services and remote access applications, businesses must adhere to these standards. Business applications for cloud computing must be accessible through computer systems that are online or in the cloud. Accessibility to the programmes that are constantly and everywhere open to users. Organizations and businesspersons can use cloud-based apps provided by various suppliers to arrange meetings and send and receive emails or messages. Additionally, cloud computing has improved mobility. Businesses can use a laptop or smartphone equipped with a web browser to access cloud services.

C. Scalability Cloud computing is a scalable model which enables on-demand company scalability. Examples are SaaS, PaaS, IaaS. Scalability is another feature of cloud computing that can be beneficial. Depending on the current demand for services, a business can reduce the number of virtual servers it uses at any time. The room they require or adjust it to their preferred pattern of growth. This is cost effective especially for smaller businesses that are trying to save cost. Small businesses do not have to pay a fixed amount for a dedicated data center hosting but can scale up the kind of space needed on a dedicated server. This really saves the company cost.

CLOUD COMPUTING CHALLENGES

Cloud computing technologies has numerous challenges for several sectors of handling data and information. Consequently, if you choose to deploy cloud infrastructure services, you may face the following difficulties and dangers.

[35]

A. Security and privacy

These include the organizational and technical difficulties of maintaining a sufficient level of data privacy and security in cloud services. This guarantees that serious security and privacy problems about the security and privacy of crucial or sensitive data for a business, like banks, arise when government entities use the cloud. Although it is widely accepted that service level agreements between cloud service providers and customers are required, there are currently no formal safety requirements. Things like machine detection, side-channel assaults, encryption, and authentication are among the data security and privacy issues.

B. Interoperability and portability Service portability between different cloud providers is leading to several issues. Due to the lack of defined formats and interfaces for managing virtual appliances and

uniform interfaces for interacting with different clouds, this issue exists. There is currently no standard way to communicate with clouds. Instead, many cloud providers present various APIs. Standardizing APIs among the many cloud service providers is necessary to develop a common cloud interface.

C. Legal issues

The use of cloud resources as a utility has raised numerous legal concerns. Data placement is the primary problem. Different regions and jurisdictions have very different laws and regulations regarding where, how, and how long data should be stored. Regarding the disclosure of data in general and sensitive data in particular for instance data from financial and health sector, compliance requirements may differ. In addition to the issues of identity definition, such as users versus system and issues of authentication and authorization, another significant issue is the absence of comprehensive legislation on liability in the cloud.

D. Economic Challenges

The cost of the physical infrastructure and the administrative costs connected to it are essential in determining the viability of the business from an economic perspective. This issue has to do with the cost-benefit element of cloud computing. Cloud service companies must develop efficient monetization plans that will yield a respectable return on their efforts. The plan calls for developing viable pricing structures, implementing licensing plans, and grouping resources. Since diverse providers handle invoicing and payments, it might be difficult to ascertain the type, calibre, and availability of services that the consumer is paying for. Financial benchmarking and evaluation of various providers are therefore challenging.

E. Data Management

Due to the increased data-intensive applications that cloud computing enables at the largest scale, there is an increased need for efficient data management solutions. Data storage falls under this heading. Data segmentation, recovery, location, authenticity, anonymization, and backup are all parts of data. Data retrieval and processing are additional problems with cloud computing across different data centers.

F. Service Management

Service management faced various difficulties with the cloud-based IT strategy. The capacity to offer individualized and more context-sensitive services present another difficulty. For a variety of reasons, managing the service life cycle and service registry has proven to be difficult.

CONCLUSION

In this research, we discussed the architecture, types, characteristics of cloud computing is key in information technology as it reduces cost for organizations and makes it easier to access files. It also helps to reduce data delay and redundancy. Any organization that wants to adopt cloud computing should consider the key challenges which is security and privacy.

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