Pre - Print Version
Implementation and Challenges in Cloud Computing

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Abstract: **: Cloud computing, an emerging field in Information Technology (IT), resides at the crossroads of three principal trends: standardization, virtualization, and the service-oriented approach to IT, leveraging the internet as its primary medium. Acting as a key platform for distributing resources such as infrastructure, software, business processes, applications, and hardware, cloud computing simplifies usage. Users or developers can now benefit from these services, even without specific knowledge, expertise, or control over the underlying technology infrastructure. Fundamentally, cloud computing embraces a blend of Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS). The focus of this review is to analyze the scientific literature on cloud computing. In this study thoroughly researched more than dozens of papers and find the core challenges.**

Keywords— **Cloud Computing; Communication; Information Technology, Implementation**

INTRODUCTION

The word "Cloud Computing" simply means "Internet Computing", and it can be defined as providing information technology-enabled services by using the internet to business organizations, authorized people, and users. The online resources easily can be used and accessed by common users and there is no need for any technical or physical maintenance. Cloud computing is very scalable and dynamic. In cloud computing, the resources are available remotely and can be used from any part of the world where the internet exists. Cloud computing is cheaper because there is no need to purchase hardware or software and also there are no maintenance issues. Users always keep off the cost of long-term improvements on services, software, and hardware when they pay a provider only for what they use. Cloud computing can rent a server(s) virtual servers to execute remote applications without installation and software can be executed on it. The authorized applicants can store and secure huge

amounts of data.

The applications over the internet that protect and store data can be used through cloud computing while rendering services. Cloud computing can also be used for the storage of data that data can be business or personnel. In cloud computing web applications behave like desktop applications like word processors, photo editing, and GPS.

Although cloud computing is a very useful feature, there are implementation issues due to the lack of standards as shown in Fig. 1.

The current scientific research in the field of cloud computing. This study aims to identify the implementation issues, limitations, and challenges faced in the implementation of cloud computing. The rest of this paper has been structured as follows: a literature review has been presented followed by the critical analysis of the reviewed literature. Lastly, a conclusion and possible future directions have been presented.

Figure 1. Implementation Issues in Cloud Computing

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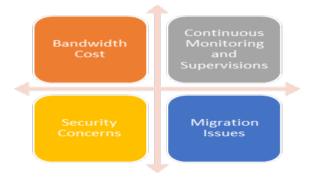
LITERATURE REVIEW

The study by Dilip et al. focuses on studying the usage of cloud computing in healthcare data management and is briefly summarized [1]. It highlights the importance of safely keeping

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and managing enormous amounts of patient data for use in the future. The paper successfully depicts the healthcare sector's multifaceted nature and acknowledges the present difficulties it is facing, particularly in light of the epidemic. Overall, it offers a concise and enlightening explanation of the goals and conclusions of the study, demonstrating the potential advantages of cloud computing for the healthcare industry.

The expanding difficulty of cloud properties and services has been highlighted in this study by Kazheen et al., who also emphasize the need for cutting-edge solutions to handle issues with portability, interoperability, security, selection, negotiation, discovery, and definition of cloud services [2]. The review examines the part of semantic technologies in cloud computing and highlights their potential to increase automation and efficiency in managing cloud applications. Semantic technologies are recognized as a potent solution.

Zainab et al. concentrated on using ontology and the semantic web in cloud computing to address issues with security, dependability, discovery, service selection, and interoperability [3]. An intelligent SaaS framework, resource access control, and a cloud computing marketplace are some of the suggested solutions. Utilizing these technologies can improve the effectiveness and efficiency of cloud services overall.

Vouk et al. describe in this study about cloud computing research and implementation issues and also describe research fields and issues in these areas the implementation in this study is done based on Virtual Computing Laboratory technology [4]. The Virtual Computing Laboratory technology is the recent method of cloud computing implementation this technology was invented by NC State University in 2004. The Virtual Computing Laboratory implementation of cloud computing opens a lot of new areas in the field of research and opens a lot of new directions like economy-of-scale and economics of image and service construction. The author also discussed the open issues including: A user cannot store information permanently as he becomes online from anywhere at any time he must come up with a standardized schema. Another issue pointed out by the authors is that there is no way in the present cloud computing architecture which make information standardized he suggests that the system should be modularized and integrated and data must be delivered logically in front of the user.

Bo Peng and Bin Cui and Xiaoming Li present the T platform in which they discussed lots of cloud computing implementation issues practically [5]. They search out lots of implementation issues like the data which is transferred from one user to another user is uncontrolled and with the help of the new T platform implementation model data will schedule automatically the new model of implementation provides chances for avoiding network congestion the network congestion always degrades the performance. Another implementation issue which is discussed in this study is that

data with indigenous types will not be efficaciously serialized this thing always decreases the performance rate in most cases.

La'Quata Sumter et al. suggested that the implementation of clouds should be large rather than small number because this assumption will provide a more compatible and comprehensive system which is based on this idea [6]. The study describes the requirement for a security control device over the cloud, that device permits the users and makes them satisfy that their information is secure and protected from any threat or any cyber-attack on that cloud. This study also suggests an auditing agent to extend this study in the future the concept of an auditing agent is to validate this research and approach. This study resolves the problem of security concerns of cloud customers, cloud users have always concern that is their information is secure and protected or not. The author raises the question is that if one user stores the data in the cloud is the same resources will be used by another user or not. To resolve this issue, this study introduces a security device.

In the study by Junjie Peng et al. the caparison between different platforms says of cloud computing have been doing this thing is helpful for users to understand different cloud computing platforms and the issue in these platforms [7]. The platforms which are discussed in this research are Cloud Computing Platform, Eucalyptus Cloud Platform, Nimbus Cloud Computing Platform, and Opennebula Cloud Computing Platform. At present, there are different types of cloud computing platforms and each platform has its advantages and disadvantages, and implementation issues for better and precise comparison of cloud computing platforms are as shown in Table 1. It shows that the implementations of these platforms are different from each other and there are also some similarities between them like they support IaaS, all are scalable and all of them are supporting the Linux operating system.

Table 1. Comparison of cloud computing platforms

Cloud Platform	Description	Key Features	Pricing Model	Popular Use Cases
Amazon Web Services (AWS)	Cloud platform by Amazon	Range of services, scalability, global infrastructure	Pay-as-you-go, usage-based pricing	Web application, Big Data, AI/ML
Microsoft Azure	Microsoft's cloud computing platform	Hybrid capability, extensive service portfolio	Pay-as-you-go, usage-based pricing	Enterprise applications, DevOps, AI/ML
Google Cloud Platform (GCP)	Cloud services provided by Google	Advanced machine learning, big data processing	Pay-as-you-go, usage-based pricing	Web applications, Data analytics, AI/ML
IBM Cloud	Cloud platform by IBM	Strong focus on enterprise-grade security	Pay-as-you-go, usage-based pricing	Enterprise applications, DevOps, AI/ML
Oracle Cloud	Cloud infrastructure and services by Oracle	Integrated database services, high performance computing	Pay-as-you-go, usage-based pricing	Enterprise applications, Database managem

Alibaba Cloud	Cloud computing services by Alibaba	Scalability, AI capabilities, strong presence in Asia	Pay-as-you-go, usage-based pricing	E-commerce, Web hosting, Big Data
DigitalOcean	Cloud platform for developers and startups	Simplicity, developer-friendly tools	Pay-as-you-go, fixed monthly pricing	Web applications, Development environments

Harold et al. have worked on issues faced while automation of cloud computing [8]. Cloud services vendors are providing powerful advanced virtual resources. Virtualization is getting popular with consumers because it provides features of elastic cloud computing which allows them to arrange resources for guest applications to be hosted. In this study, the researchers have addressed issues of creating efficient tools for controlling Consumer add-ons on the exterior of the cloud services. These external controllers will respond to the limitations of cloud utilities; they have identified concerns that differentiated cloud computing feedback mechanisms from other forms of computing feedback mechanisms. They have also shown that previous works in this area of cloud computing are also related to the process of automation in cloud computing. They have introduced the concept of a proportional threshold control policy. The advantage of this study is that it addresses the issues faced while automating cloud services.

Dominik Birk states that cloud computing is very popular these days due to its characteristics and advantages [9]. Still, cloud computing is not widely accepted due to its implementation issues, and hence customers are still resisting moving their data centers to the cloud. The most important concern to the consumers is the lack of security assurance to the users and the availability of the services when required. In other words, consumers don't trust the service providers. Consumers of cloud services are not aware of backend operations; they don't have physical access to the cloud. In this work issues in digital forensics and implementation hurdles in investigation mechanism for post analysis has been discussed. The strength of this work is the identification of problems that occur in post-investigation in digital forensics that will help service providers to deal with security issues. The limitation of their work is that they haven't proposed any specialized framework to address the issue.

Rituik et al have worked on the metering issue faced by users of cloud computing [10]. Their work is extremely beneficial for the consumers of cloud services as their proposed toll will enable consumers to verify the billed amount charged by the vendors. They have addressed the attacker model and proposed solutions are also discussed briefly. Their work needs to be recognized by giants of cloud services.

Cloud computing evolved from grid computing and software as a service become the foundation for cloud computing [11]. The theme of cloud computing is providing services remotely through distributed computing, involving a large number of distributed resources. This goal is achieved through the internet as cloud computing services are accessed via the internet. The study discusses cloud computing, its history, characteristics, advantages, and disadvantages. Cloud computing no doubt is useful for those who require it in their companies and businesses. For organizations, cloud computing is important because it reduces the costs of establishing their infrastructure and even maintenance is not a headache for enterprises. This form of computing helps businesses to earn more profit as the cost is reduced. Cloud computing facilitates everyone. The advantage of this study is enabling consumers to know about the advantages and characteristics of clouds, this study also helps service providers to know about the issues associated with clouds. The study claims that cloud computing will grow more once the implementation and security issues are addressed by the vendors.

Liladhar and Ujwal have discussed cloud computing and the reasons for its popularity [12]. The paper mainly focuses on the implementation of web applications on cloud servers. The entire implementation process is discussed in this paper and the problems faced in the implementation process are identified. The study identified that users have serious concerns about the availability, reliability, security, and privacy of their data. Web applications hosted on a web server use distributed client-server architecture; the application is accessed via a generic web browser from the client side using HTTP. The existing implementation mechanism assures the confidentiality and integrity of the information that is manipulated. Virtualization allows a single machine to be seen as multiple independent machines, this thing became the cause of the success of cloud computing. The advantage of this study is discussing the issues in implementing and managing web applications on clouds and the drawback of this study is only theories are discussed nothing practical is found, and no model is proposed.

Jansen discusses cloud computing, its structure, and security issues briefly [13]. The contribution of the work done is the identification of security concerns that will enable consumers and vendors to know about the security risks associated with cloud services. The paper discusses cloud computing in detail and then the threats, issues, and problems faced by the consumers are discussed in detail. This study is based on theoretical concepts and nothing practical is discussed. The notable thing is that: no model, tool, software, or prototype has been developed. This paper could have been more useful if based on theoretical research at least any model or tool was proposed.

Sanjay et al designed, developed, and implemented the entire file system for Google File System [14]. The system is scalable and easy to use and implement. They claim that their proposed file system is fault tolerant and does not require

specialized hardware for implementation, the system can be implemented on a normal infrastructure. The system is capable to deliver applications efficiently to a large number of clients. The proposed system is offering all the features of previous file systems along with the new features identified in the requirement phase. The newly designed file system meets all the requirements of the company and stores data in a way that it can be used for research & development work. They claim that the designed file system is the first ever system being developed which provides hundreds of terabytes of storage, that is shared among thousands of distributed machines. The machines on which data is stored are clustered together and the clustering is transparent to the users. The study also presented extensions of the file system that supports distributed applications. The design, development, and need assessment are done from different perspectives.

The strength of this study is the designed system and proposed model GFS, which supports large-scale data set processing, the system is fault tolerant and provides data replication features. The performance of clusters is also monitored and seems satisfactory. According to our exploration, we found that Improvements in the networking stack are still needed to boost the performance, and a user manual must be provided to the professional which contains implementation guidelines for the administrators.

Cloud computing is getting popular because of its benefits and its characteristics, cloud computing is associated with an array of issues [15]. Lee discusses the pros of cloud computing and they use of cloud computing in the scientific computing. Virtual machines are very useful in scientific computing and as we know that cloud computing is simply virtual computing. Virtual computing decreases implementation issues to a great extent. Further, they claim that they have driven standards for cloud computing to get optimized performance. The paper discusses the deployment trajectories of the cloud (see Figure 4), the paper states that the software as a service (SaaS) infrastructure must be extended to model as a service (MaaS) to achieve the scientific computing. The paper is very useful for the scientific community as the study provides a detailed identification of issues in cloud computing, this study is done from is perspective of scientific computing. The outcome of this study is discussing, and addressing issues, and proper recommendations for every issue are also given.
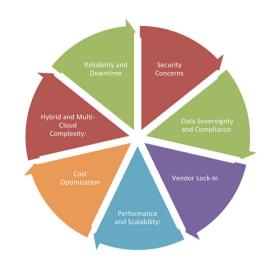

Figure 2: Deployment Issues

According to Ruth et al., cloud computing is fresh computing and is evolving rapidly but still, a lot of things need to be addressed [16]. IT Giants like IBM, Microsoft, and Google are working to resolve issues that are affecting the wide acceptance of Cloud computing. Organizations are focusing on the design and implementation of clouds; everyone wants a simplified design and implementation process. Since cloud computing provides availability, the consequences of cloud computing need to be explored including access control, regulatory, legality, security, privacy, development, and implementation issues. Cloud computing has evolved the field of web services and everything in cloud computing is delivered as a service. The widespread success of cloud computing is due to its features like the delivery of software as a service and Infrastructure as a service. They have proposed a poster to be created in which they will outline the results of workshops related to cloud computing, they have proposed that workshops must be conducted to address the issues of consumers and vendors researchers and IT professionals and consumers must sit on the same platform and interact with each other to identify issues and discuss their possible solutions. The study gazes on theoretical Directions for developing a cloud computing setup. The work has limited usefulness as it discusses only limited theoretical work.

Alex et al. have highlighted the usage of the Predictive Model Mark-up Language (PMML) standard used to exchange models among applications [17]. They have also discussed the currently paid inclination in the field of cloud computing and especially the Seas model. To illustrate the advantages, they have mixed cloud computing with the predictive Mark-up Language and have proposed a new platform based on cloud computing. They have illustrated the advantages organizations can get by combing open standards and cloud

computing. The new platform describes a predictive analytical platform that simplifies the implementation process for statistical models. The strength of their work is combing cloud computing and Mark-up Language (PMML) standards. [23] "The combination of open standards and cloud computing offers a true revolution in the way data mining models are approached. In addition to accelerating the process of deployment, which allows for businesses to start benefiting right away from their predictive analytics solutions'. The drawback is it needs a huge cost for deployment and needs further improvement in the future.

Juan Du et al. emphasize the crucial importance of implementing necessary security protection for security-sensitive applications, particularly those involved in processing secret data [18]. It is essential to ensure security when transitioning such operations to shared, publicly accessible cloud environments. In this paper, the authors propose a framework called RunTest, with a focus on ensuring integrity attestation during the transformation of data to public clouds. RunTest employs attestation techniques to identify integrity issues and malicious service providers. The authors have successfully deployed RunTest in the IBM data flowing system and conducted tests in the NCSU lab. The proposed tool effectively operates in data flowing systems, guaranteeing the integrity of data processing outcomes and uncovering potential security risks from untrustworthy cloud computing service providers. However, it is worth noting that the tool may face limitations in complex cloud computing environments. For a more comprehensive understanding, please refer to Table 2, which provides a critical analysis of the proposed approach.

CRITICAL ANALYSIS

Ref	Research Context	Issues Discussed	Technique Used	Strength of work	Limitations	Model/Tool
[1]	Semantic Web & Cloud Computing	The growing complexity of cloud services	Cloud-driven	Potential to enhance efficiency	Limited focus on implementation	No
[2]	Cloud Service / Performance Implementation	Handle issues with portability, interoperability, security, selection, negotiation, discovery, and definition of cloud services.	Cutting-edge solutions	They examines the main role of semantic technologies in cloud computing and highlights their potential to increase automation and efficiency	Implemented cutting-edge solution	No
[3]	They have focused on Ontology implementation in Cloud Computing	They used the RDF and OWL semantic technologies in the modelling.	They Worked RDF & OWL Modeling for semantics used.	The system is very effective in increasing coordination the interoperability	Just a literature review with no framework defined.	No
[4]	Cloud Computing Issues Research and Implementation	Used SSH tunnels and VLANs, demonstrable integrity and end-to-end service isolation through VPN	Done experiment on Virtual Computing Laboratory (VCL) Technology	Implementation issues are identifies	Based on theoretical concepts, less practical description.	No
[5]	Implementation Issues of A Cloud Computing Platform	System Design Criteria, Implementation of Inter-machine communication, System Debug, and Diagnosis	TPlatform	Issues related to implementation are identified based on theoretical and practical concept	Implementation of Tplatform has to be done.	Yes
[6]	Cloud Computing: Security Risk	Providing security guarantees to cloud users, and tackling security challenges during implementation.	They done their Experiments Trusted Cloud Computing Platform (TCCP)	Security assurance to end users of the cloud	Test done on less machine.	Yes
[6]	Comparison of Several Cloud Computing Platforms	Implementation issues of different cloud computing platforms	There is no technique used in this study.	Discussed implementation advantages and disadvantages of several cloud computing platforms.	Issues are identified in different cloud computing platforms but solutions are not provided.	No
[8]	Cloud Computing: Challenges, Opportunities and Automated Control	addresses the challenge of building an effective controller	proportional threshold API is used in this study	A new feedback control policy introduced that policy is the proportional threshold.	Not practically deployed, just a literature review	Yes
[9]	Technical Challenges of Forensic Investigations in Cloud Computing Environments	New Digital methods for investigation	Snapshot and live investigation techniques are used.	Investigation techniques are discussed	Nothing practical was discussed or implemented. No tool/model Proposed	No
[10]	Addressing security issues in cloud computing.	Metering problems, Proof of work, Attack scenarios & Data Backups	The metering Solution, Simulation	Users have authorized to verify billed by service provider, also provide they have provided security.	Limited focused on performance .	Yes
[11]	Cloud Computing Research and Development Trend	Privacy, implementation, and security issues	Theoretical Research	The real issues of cloud computing are discussed and the solution is proposed.	The theoretical solution is given a model or graphical representation not provided.	No
[12]	Implementation of cloud computing on web Applications	Privacy, Security, Legality, Mentality, Standards & Energy Consumption issues.	Virtualization	Advantages & Disadvantages discussed	Problems are identified but not addressed	No
[13]	Cloud Computing Security and Privacy	Building trust among end users, managing insider access, ensuring visibility, implementing risk management strategies.	Review	End users about potential risks to privacy and security.	Review present	No
[14]	The Google File System	The design and implementation of the Google file system	Theoretically and practically GFS model implemented	The proposed model (GFS) supports large-scale data set processing, fault tolerance, and replicating crucial data.	Improvements in the networking stack are needed	Yes
[14]	A Perspective on Scientific Cloud Computing	Standard, Challenges, and issues in cloud computing	Theoretical Research	Discussed deployment of cloud computing standards OCCI, OVF, and CDMI	The Problems and issues are discussed but a solution is not proposed.	No
[15]	Best Practice in Cloud Computing: Designing for the Cloud	Theoretical designing and implementation of cloud	D.2.0, D.2.2, D.2.3, D.2.5, D.2.6, D.2.9, D.2.12, D.2.13	Theoretical Directions for Developing a Cloud	Practically not implemented and no model proposed.	No
[16]	They focused on efficiency and performance of cloud computing	Implementation of Predictive Analytics	Predictive Model Mark-up Language (PMML)	Deployed a new standard (PMML).	It needs a huge cost for deployment and needs further improvement in the future.	Yes
[17]	The integrity of Data flow Processing in cloud computing infrastructure	This research focused on the security applications and identified the malwares	Framework on Run Test Attestation	Easy to ensure the integrity and authentication and secure for data	Difficult to implement in the large scale	Yes

CONCLUSION AND FUTURE WORK

We have reviewed scientific research papers in the field of cloud computing, and we concluded that no doubt cloud computing has gained significant attention from consumers, businesses, and companies are shifting their IT setup to cloud computing. The most attractive feature which attracts clients is the delivery of software, infrastructure, platform, and Hardware as a service. Users can access their required services remotely via the Internet. This era of computing has dramatically changed the entire computing world, consumers just need to avail of services and pay for what they use, and they can even host their customized applications on cloud servers and access them remotely via the internet. Cloud computing delivers computing in the form of services in general life we take the connection of electricity, gas, water, and telephony and we have to pay for the quantity we have used. So in a nutshell cloud computing has changed life of consumers and businesses. Cloud computing is yet not perfect as there are some serious concerns associated with it, the primary one is the issues faced while implementing the clouds, then security and privacy issues, and then quality of service issues. These all issues are affecting the wide acceptance of clouds; IT giants are working hard to address the issues associated with cloud computing. Our aim of this study was to identify the implementation issues, since our study was based on a literature review so we reviewed different papers to know about the problems and concerns of cloud computing. We propose that standards for implementing cloud computing must be established and validated to standardize the implementation process. This will help in improving the implementation process and if standards are established then IT professionals will not face issues in establishing clouds. Our proposed solution is setting standards to address all the implementation issues. In, future, we will develop prototype to encounter this problem.

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