A REVIEW ON SECURITY VULNERABILITIES IN CLOUD COMPUTING

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ABSTRACT

Way before the emergence of the cloud computing phenomena, there has been an insatiable demand for research from all corners of the globe. Cloud computing is considered the foundation of the next generation computing revolution, and it is quickly becoming the trendiest issue in the IT world. This rapid shift to Cloud computing has sparked worries about a crucial aspect of information systems, connectivity, virtualisation, availability of data and integrity, public auditing, scientific application, and information security. As a result, cloud computing research has received a lot of attention in recent times. This paper reviews open difficulties and issues in Cloud computing. The study is separated into three sections: first, we examined the cloud computing architecture and the various services it provides. In second section, based on its service layer, we identified numerous security vulnerabilities in cloud computing. Furthermore, from the perspective of Cloud computing adoption, we highlighted numerous open issues as well as their future consequences. Lastly, we have discussed about the platforms relevant for cloud research and development in the contemporary period.

Keywords: Cloud computing; Cloud security; Virtualization; Workflow scheduling; Data integrity, Public auditing

I. INTRODUCTION

Computing resources are becoming cheaper, more powerful, and more widely available now than they were ever before, due to the increasing popularity and quick expansion of processing and storage technologies, as well as the emergence of the Internet [1]. This technical development is commonly referred to as cloud computing, and it has resulted in an evolving method of meeting present and future information and communication technology (ICT) needs. Cloud computing provides a flexible online environment that allows you to manage a larger amount of work without impacting the framework's performance. The rising demand for cloud - based providers and the range of service offerings have made it tough for researchers to comply with the various difficulties that have arisen with the introduction of cloud computing. Researchers have been working throughout the world for years to allow this technology to be used in a broad range of business applications and in many other sectors of IT infrastructure, leveraging cloud computing services and mechanisms

The use of cloud services fosters a growing relationship between public and private sector entities, as well as the individuals they serve. Cloud computing is appealing to major corporations because it minimizes the need for customers to plan accordingly for deployment and allows businesses to start small and scale up only as service demand increases [2]. Advertising and expanding cloud offerings created a massive build-up around the cloud, which resulted in high user anticipation stress that could only be partially met - as is the case with most effective applications or conceptions. Marketing has a tendency to ensure characteristics that are easily confused with qualities that have various connotations in different areas, potentially leading to cloud misunderstanding. As a result, a detailed definition of cloud application characteristics is critical for the cloud framework's future development.

Considering cloud infrastructure is utilised all around the world, security is a big problem. This framework sharing, along with the fact that cloud clients want complete control over the entire foundation, presents significant security concerns. The architecture of clouds varies depending on the services they supply. The data is kept in a condensed region known as a server farm, which houses a large amount of data and processes it in the server. As a result, consumers must have faith in the cloud resource provider's

accessibility as well as data security. The sole legal agreement between the service provider and the client is the service level agreement (SLA). The SLA is the only way for the provider to gain the confidence of customers, thus it must be institutionalised.
This article analyses existing patterns in the realm of Cloud computing and provides study space for future advancements of this technology, based on available data and rising expertise in the field. The key aspects of opportunity in cloud research are presented, with each one being thoroughly described. [5]

II. CLOUD COMPUTING ARCHITECTURE

The phrase "distributed computing" believed to have originated with a machine system standard that refers to the internet as nothing more than a cloud. IBM (2009), Sun Microsystems (2009), Gartner by [6], Forrester Research by [7], and [9] are just a few of the real-world IT companies and market research companies that have published white papers attempting to determine the definition of cloud computing. These debates are essentially coming to a close, and a standard definition is taking shape. The essential characteristics of cloud computing are as follows: [2] [8]

On-demand self-service:

By registering, resources may be obtained and used when they are needed, without the need for human interaction with cloud administration providers. Computational power, bandwidth, virtualization software, and other computational resources are all examples of computing resources.

Broad network access:

The above mentioned resources can be accessed via a system using a variety of devices, such as laptops or mobile phones

Resource pooling:

Cloud administration providers club their resources, which are subsequently distributed to a large number of customers. This is referred to as multi-tenancy, in which a real server, for example, could have a few virtual machines each with their own set of customers.

Rapid elasticity:

By scaling out, a client may quickly obtain more cloud resources and then curtail in by releasing those resources when they are no longer needed. Storage use, CPU hours, bandwidth usage, and other metrics are used to gauge resource utilization. The aforementioned metrics apply to any and all clouds, and so each cloud offers services at a distinct degree of abstraction, that is an alternative to management. The three most common service models of cloud computing Through capabilities known as services, a cloud may cooperate with a customer/client in a variety of ways. Three primary types of service models have evolved throughout the internet.

Software as a service (SaaS):

Allows users to access software that is offered as a service over the internet using apps that operate on a cloud infrastructure and are accessed through a web browser. With the possible exception of restricted client specific application configuration options, the consumer has no control or understanding of the fundamental framework, which includes the system, servers, networking, software platforms, storage, or even individual application capacities.

Infrastructure as a service (IaaS):

Allows a customer to use an IaaS provider's computing, storage, networks, and other basic computational resources to install and execute any software, including software applications, services, and applications. The client has complete access over operating systems, storage, installed applications, and maybe limited control over some system management components.
The four deployment models of cloud computing are as follows:

A cloud organization model shows ways resources are shared within the cloud. The four cloud deployment are private cloud, public cloud, community cloud, and hybrid cloud. When evaluating scalability, dependability, safety, and affordability, each model has an influence. [4]

A private cloud is one that is utilized solely by a single firm, organization, or one of its clients. The cloud might be managed by oneself or by a third party; a private cloud provides more security at a higher expense. Concur Technologies (Lemos, 2009) and the St. Andrews Cloud Computing Colaboratory6 each have their own private cloud.

The term "public cloud" refers to a cloud that is accessible to the whole public. The cloud would be less appropriate due of its openness. The public cloud is the most cost-effective choice. This might be a huge company that provides services. Large businesses such as Microsoft, Google, and Amazon typically own public clouds, which demand substantial expenditure.

Community cloud: A cloud which is managed by two or more organizations or businesses and is often configured to meet their particular needs. This is usually done in the case of a common concern (e.g. such as schools within a university).

A hybrid cloud is one that is created by combining two or more private, public, or community clouds. The hybrid cloud may be flexibly supervised while allowing apps and data to roam across the cloud.

III. OPEN CHALLENGES

Handling Uncertainties:

Uncertainty has been shown to be one of several challenges in supplying cloud assets [10] [11]. Client location, content kind, unpleasant workouts, heterogeneity, and other factors all contribute to resource uncertainty. Sometimes, a multimedia content delivery programme may face resource disappointments or the negative impacts of a lack of adequate resources. Given that bandwidth is among the most valuable resources, particularly in multimedia applications, a shortage of bandwidth can result in significant QoS deterioration.

Three variables influence the amount of bandwidth used in multimedia applications: 1) Demand for bandwidth from media applications; 2) Demand for bandwidth from the user's workload; and 3) Demand for bandwidth from the user's location and device type. These variables vary fast, therefore there may be a bandwidth bottleneck at times. Anticipating these elements is essential for providing enough bandwidth:

- Predicting the size of incoming video frames based on the transient history of previously seen frames in a multimedia application network bandwidth requirement.
- Demand for bandwidth by the user's workload: Considering the history of past requests, estimating user workload (number of persons requesting video).
- Multimedia application resource demand: Forecasting and recording the link among multimedia application Qos targets, existing hardware equipment allocation, and alterations in client workload patterns in a structured manner
- The cloud resource provisioner can allocate the right amount of bandwidth by anticipating the aforementioned parameters

Handling dynamic variations in workload:

One advantage of hybrid cloud systems that hasn't been discussed before is their ability to withstand workload surges. The local data centre, in addition, might be supplied of adequate server capacity to accommodate workloads, but cloud assets could be called in as needed to address surges. The technique might potentially aid in the creation of formats that can handle a wide range of workload variations. One approach would be to use the model to narrow down the best configurations for a diverse set of workloads, then base the final configuration on the predicted probabilities of each task.An alternative option is to use the model on a regular basis as workloads fluctuate throughout time to determine whether a shift in placement is required. More in-depth analysis of these concerns can be granted, as well as the opportunity to work on them.

Optimization of Virtual Network Topologies:

Virtual machines (VMs) in virtualized data centers communicate with one another on a regular basis, forming virtual system hierarchies. However, due to VM migrations or a lack of efficient allocation, communicating VMs may be placed on logically distant physical nodes, resulting in costly information transmission. Unless the communicating VMs are distributed across hosts across many racks or enclosures, network connectivity might entail network switches that consume a significant amount of power. To eliminate this information transmission latency and reduce power consumption, it's critical to monitor VM communication and locate vms or on the same nearby nodes. To provide convincing reallocations, network devices' power usage models may be built, as well as the cost of information transmission can be assessed based on traffic volume. Because relocations use more energy and have a detrimental impact on execution, the re-allocation controller must ensure that the cost of migration doesn't somehow exceed the profit before initiating the relocation

VMs Consolidation for Managing Heterogeneous Workloads:

Users can purchase virtual computers and allocate any type of usage to them using cloud infrastructure services. This influences how different types of uses (e.g., corporate, scientific, and social network applications) are assigned to a single physical machine node. However, it is unclear how these apps will interact with one another, since they may be data, network, or computation heavy, putting a fluctuating or static burden on the resources. The problem is determining which types of applications should be assigned to a particular host in order to maximize total resource usage. The issue of consolidating different types of workload is not addressed in current techniques for energy efficient VM consolidation in data centers. These approaches usually focus on a single workload type and therefore do not take into account different types of usage while assuming a uniform workload. Unlike prior research, an intelligent consolidation of VMs having various workload types may be offered. [19] Because the former relies mostly on CPU performance, whereas the latter depends on disc storage and network bandwidth, a compute demanding (scientific) programme can be successfully coupled with a web application (file server).Which types of applications may be efficiently integrated and also what characteristics impact efficiency, as well as developing resource allocation algorithms for managing them, should be researched for a better approach, in our opinion. Furthermore, such data may be utilized to energy-efficient resource management techniques in data centers to achieve a more ideal optimum resource allocation and, as a result, improve resource utilization while lowering energy consumption.

Scientific Workflow Scheduling:

In fields like biology, astronomy, and physics, cloud computing provides enormous potential for solving large-scale scientific issues. As cloud computing has grown in popularity, it has encountered a number of problems, including performance fluctuations and breakdowns. Performance fluctuations have an impact on the workflow's overall processing time, whereas failure has an impact on the workflow's overall runtime. The workflow scheduling problem for distributed systems has been extensively investigated over the years and has been reduced to an NP-hard problem [17].Present Cloud workflow management focuses on homogenous resources, with relatively few attempts made for heterogeneous types of resources, with [18] making one of the first attempts. While scheduling processes, workflow management systems should account for performance fluctuations and failures.

Public Auditing:

The prevalence and quick expansion of cloud storage services to share information has raised concerns about the data integrity kept in the cloud, as cloud storage can be easily lost or harmed due to unavoidable hardware/software failures and human mistakes [20]. There are a variety of conventional methods for ensuring data accuracy. The accuracy of cloud data may be effectively checked using traditional methods. Nevertheless, the efficacy of applying this standard technique on cloud data is questioned, because it requires retrieving all of the data first from cloud and then verifying data integrity by validating the accuracy of all of the data's signatures [21]. Public auditing [22] is a technique for efficiently doing integrity checks without having to download all of the data from the cloud.

Expert integrity checking is provided by a public verifier or a third-party auditor. Throughout public cloud information auditing, the contents of a client's personal data isn't really exposed to any public verifiers. As a result, a new important privacy concern is introduced: the disclosure of identity privacy to public verifiers. If identity privacy on shared data is not preserved during public auditing, public verifiers will get access to sensitive information. Finding ways to assure the integrity, security, and privacy of cloud storage remains a difficult research challenge.

Data Availability:

The property of a framework being available and used upon interest by an authorized entity is referred to as availability. The term "system availability" refers to the capacity to continue operating even when authorities are misbehaving. Even if there is a security breach, the system must be able to continue operating. Perhaps it includes the data, software, and hardware that are made accessible to authorized users on a demand basis. Customers may also access data and data management over the cloud if they are interested. System availability refers to a framework's ability to carry on activities even when some authorities are at fault, i.e. it must keep running even if security is compromised. Cloud computing services are extremely reliant on resource frameworks and network availability at all times.

VI. CONCLUSION

This paper analyzes the primary research difficulties surrounding cloud computing's advanced scientific aspects, including layer-wise classification of cloud services, as well as the following research recommendations confronting both the industry and academic community. This study, as well as future concerns, indicated that the cloud research group can benefit from related groups in a few ways. We've provided a comprehensive overview of current research challenges in cloud computing as well as a platform for simulating research ideas. We have demonstrated scientific classification of concerns identified here, as well as the techniques used to address these issues, focusing on operational, service user, services, and actual outcomes, encryption, and context-awareness..

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