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Implementation of Cloud Computing in IT Industry

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Abstract: *Organizations must invest time and money to scale up IT infrastructure such as hardware, software, and services to satisfy ever-changing business demands. However, when you have your own premises and have invested in IT infrastructure, scaling may be sluggish and expensive. Furthermore, even if businesses scale out their IT infrastructure, they are rarely able to make the most of it. This has been a significant roadblock in businesses' decisions to commit significant cash and resources in expanding their operations. All of this has compelled businesses to seek novel solutions in the shape of new technical solutions that are both simple and cost efficient. Cloud computing is one such technology that has shown to be beneficial in recent years. The term "cloud computing" refers to a paradigm change in computing that takes place via the internet. It uses Service Oriented Architecture (SOA), which results in lower IT infrastructure costs, more flexibility, and lower total cost of ownership. However, adopting Cloud Computing is not simple, and there are a number of challenges that must be addressed before it can provide the desired results. Unfortunately, there isn't enough research out there that has looked at numerous implementation difficulties in a systematic way. After extensively reading the literature, we attempted to grasp the concept of cloud computing in depth and attempted to structure significant difficulties that may emerge when implementing cloud computing in this article. Aside from identifying these main concerns, various remedies offered by practitioners have also been explored.*

Keywords: Cloud Computing, Implementation Issues, Rapid Elasticity, Scaling Process.

I. INTRODUCTION

Organizations must invest time and money to scale up IT infrastructure such as hardware, software, and services to satisfy ever-changing business demands. However, when it comes to owning and investing in IT infrastructure, the process may be long and costly. Furthermore, even if businesses scale their IT infrastructure, they are rarely able to make the best use of it. This has been a significant roadblock in businesses' decisions to commit significant cash and resources in expanding their operations. All of this has compelled businesses to seek novel solutions in the shape of new technical solutions that are both simple and cost efficient.

Cloud computing is one such technology that has shown to be beneficial in recent years. Cloud computing is a paradigm change in computing that takes place via the internet. Client/server computing, peer-to-peer computing, distributed computing, cluster and grid computing are all examples of antecedent technologies to cloud computing. All efforts in previous technologies were directed toward high performance computing with the goal of maximising resource usage.

Cloud computing is a new IT trend in which computation and data are moved from personal computers and desktops to big data storage facilities known as data centres. As a service, deliver apps. [2]. It's the next phase in the evolution of on-demand and pay-per-use computing following Grid computing. [1] The cloud idea ensures a cost-effective implementation of utility computing by allowing services to be purchased on a pay-as-you-go basis, lowering costs and increasing resource usage. The cloud has had a significant influence on the IT ecosystem, resulting in the creation of new markets and user groups. [3] This has been split into two sections. The first section provides an in-depth knowledge of cloud computing by describing it, enumerating its key properties, and addressing the NIST model.

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The second section of the article focuses on identifying difficulties that may occur during implementation in an organisation. The existing techniques for dealing with these challenges have also been explored. In a nutshell, the key contributions of this article are:

- Developing a thorough knowledge of cloud computing and the NIST Model.
- Exploring fundamental challenges in cloud computing implementation and solutions already in use.

II. Understanding Cloud Computing and Nist Model

The National Institute of Standards and Technology (NIST) offered the most common and appropriate definition of cloud computing in 2009, which was revised in 2011."CLOUD computing" is defined as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction, according to this definition. On-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service are the five essential characteristics of this CLOUD model, which is made up of five essential characteristics, three service models (Software / Platform / Infrastructure as a Service), and four deployment models. Private, communal, public, and hybrid CLOUD deployment types are available. "A 'CLOUD' is an elastic execution environment of resources engaging many stakeholders and delivering a metered service at different granularities for a set degree of quality (of service)," according to Wikipedia.

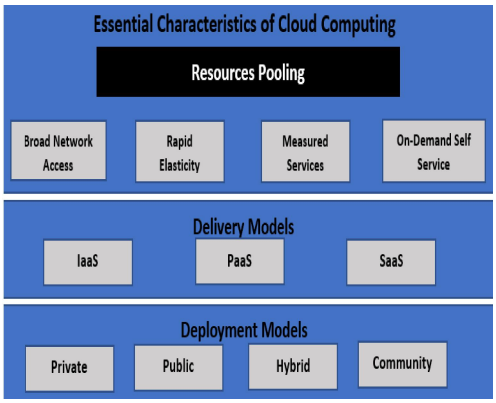

Figure 1: NIST Cloud Model [4]

The National Institute of Standards and Technology (NIST), which is one of the largest users of Cloud Computing networks in the United States, has released a set of working definitions.

2.1 Essential Characteristics

The five most essential aspects of cloud computing are as follows:

a. **Resource Pooling:** The provider's computer resources are pooled together to serve numerous clients via a multi-tenant model.
b. **Broad Network Access:** Cloud services are accessible over the network and can be accessed by any client.
c. **Rapid Elasticity:** Cloud services may simply be scaled up or down to meet the needs.
d. **Metered Services:** Metering capabilities are used in cloud computing services to regulate and optimise resource consumption.
e. **Self-Service On-Demand:** All services, including email and storage, are supplied without the need for human involvement.

2.2 Delivery Models

a. **Software as a Service (SaaS):** This is a term that refers to software that is hosted and available over the internet. The main benefit is that users may personalise their apps without compromising the basic functioning.

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b. **Platform as a Service (PaaS):** Provides a platform or runtime environment for organisations to develop and deploy runtime applications. The organisation is exclusively in charge of application development, maintenance, and administration in this case.
c. **Infrastructure as a Service (IaaS):** Gives you access to basic resources including real machines, virtual machines, and virtual storage.

2.3 Deployment Models

a. **Private Cloud:** This infrastructure is dedicated to a single company.
b. **Public Cloud:** This infrastructure is open to the whole public. A third-party Cloud Service Provider often owns it (CSP).
c. **Hybrid Cloud:** A hybrid cloud combines two or more public, private, or community clouds while maintaining their distinct identities.
d. **Community Cloud:** The cloud infrastructure is shared by a number of companies and serves a specific community with common issues (e.g., mission, security requirements, policy, and compliance considerations).

III. Research Challenges

When new technology is introduced, it carries with it certain advantages as well as some problems. This is likewise true in the case of Cloud Technology. Organizations have been more than eager to adopt Cloud Computing because of the potential benefits it offers. However, in today's rat race, everyone has focused solely on the rewards and has largely disregarded possible hazards.

Issues such as standard availability, bandwidth bottlenecks, and security, to name a few. These issues are now in front of us, and businesses have begun to notice them. These difficulties, on the other hand, are described in tits and bits throughout a wide range of literature. The publications that publish cloud-related literature are mostly journals in various computer science disciplines. So far, the research has given us some insight into a variety of difficulties. Some researchers have worked on security concerns, while others have worked on SLA difficulties, and so on. In short, there is a lot of literature on cloud computing difficulties, but none that provides a comprehensive perspective of the key challenges that arise when using cloud computing. If a firm uses Cloud today, it will be unable to discover an organised description of the possible obstacles it may experience, much alone find answers to these issues.

IV. Key Issues and Corresponding Solutions

We've included all of the key difficulties that people have when implementing and working with cloud in this area. We've also tried to find and debate the best solutions that might be utilised to address them.

4.1 License Management

The ability to migrate programmes from one virtual environment to another is the focus of licence management in cloud computing. It also includes application and operating system licencing mobility from one virtual environment to the next. Due to significant technological changes, certain licencing models in the cloud are unfriendly to users. One of the significant issues that has been identified is the lack of standards-based methods for licencing management [9]. In reality, there are a few prevalent ways to licencing management in the cloud these days -

- **Source Management:** By focusing on free and open source software, this strategy aims to reduce the need for licencing management.
- **Contractual Method:** this strategy reduces the requirement for licencing management by delegating that responsibility to a third party, usually an outsourcer.
- **A mash-up Approach:** Is a combination of tools and techniques. This technique is commonly employed in corporations, however it has inefficiencies, which is why it is not particularly effective.

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4.2 Load Balancing

As we all know, the cloud contains a huge number of resources on the internet that we may use by paying a fee known as the Pay-as-you-go model. We pay a certain amount for the services we need, whether it's a computational or storage service. The issue that arises on the site is load balancing and machine and resource scheduling. In the cloud, there are several resources and machines available to service the request. A scheduler assigns requests to machines whenever they arrive at the provider.

It is not uncommon for certain nodes to become overloaded in contrast to others owing to a huge amount of requests or during peak hours, affecting the cloud's overall performance. Because the number of users is huge and diverse, traditional scheduling approaches will not work . Researchers have devised a number of methods to address this problem. Min-Min, Max-Min, Min-Max, RASA, heuristic algorithms for dependent tasks, and others are some of the most widely used and debated algorithms.

4.3 Automated Service Management

Because the cloud uses a pay-as-you-go approach, users may change their demand for services and resources according to their needs. These criteria may be raised or lowered at any moment. As a result, the cloud model should be able to handle these elasticity flexibilities [5]. In the case of dynamic resource supply, a lot of study has previously been done. The most common techniques are to build the application by forecasting demand at each level, estimate future demand on a regular basis, and so on [6].

4.4 Security of Data

Because data is kept on the cloud, one of the most pressing concerns is security, namely if third-party data is secure. The actual data centres are not accessible to service providers. They must rely on the infrastructure provider to protect their data completely. Layered security is given at every architectural layer of the cloud for this reason. The hardware layer, like the first, must be trusted via a hardware Trusted Platform Module. Then, utilising secure virtual machine monitoring, the virtualization platform must be trusted. [7]

4.5 Data Lock-In and API Design

The application programme interface (API) is a way for a user to communicate with a service provider. Typically, they take the form of web pages. APIs come in a variety of types and forms, depending on the service provider. Because there are so many users, we must bear in mind that any APIs that are exposed to them must be user-friendly. The cloud client can run on Windows, Linux, or any other operating system. Standardizing APIs might be a solution to the aforementioned problem, allowing SaaS developers to deploy services and data across various cloud computing providers that can be accessed by any sort of client.

4.6 Cloud to Cloud federation and Interoperability

The development of a cloud federation entails the formation of a group of aggregated providers that collaborate to share resources in order to improve their services. Cloud interoperability is crucial not just for the preservation of user investments but also for the implementation of computing as a utility, much as utilities like electricity, water, and telephone are interconnected in our everyday lives. In reality, there are two methods for achieving interoperability:

1. Creating a service broker that translates messages between multiple cloud interfaces.
2. Interfaces that are universal

4.7 Bandwidth Requirement

Although cloud computing is a technology that revolutionises IT on a demand basis, bandwidth is the most obvious barrier of this technology. When dozens of users are attempting to access cloud resources, the network speed slows or stops when a high-volume transaction process attempts to reach the data centre. Various firms and researchers have offered a variety of solutions. Some examples include:

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a. When traffic increases, some cloud providers route traffic to the nearest servers.
b. High-performance edge routers can be utilised to help operators control traffic more effectively. The edge routers have the ability to process massive amounts of cloud traffic.
c. Optical fibres can be used to redirect WAN traffic in a specific location. However, the cost will rise as a result.

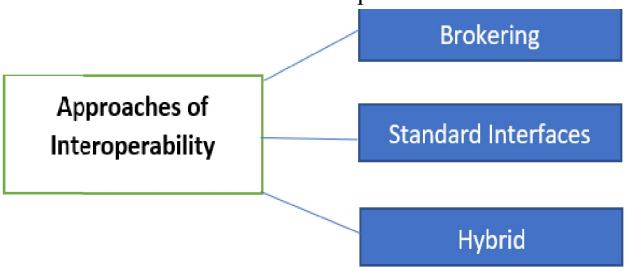

Figure 2: Cloud Interoperatable approaches [8]

4.8 Mobile Cloud

It is focused on the accessibility and use of mobile apps and data. Another important challenge is how to apply the cloud idea to mobile devices. We may call it Mobile Cloud Computing when cloud computing and mobile are combined. It is a mobile computing solution that is built on the "pay-as-you-use" approach and leverages unified elastic resources from many clouds and network technologies to give mobile users with high processing power and storage capacity with minimal resources. From the user's perspective, the primary problem that arises as a result of the structural constraints of mobile devices is whether the technology can offer the service that has been requested by a customer/user or not. without compromising service quality or maximising resource usage Elastic Mobile Apps, which are utilised to cope with this situation as these apps and may be launched on the device, are the solution for this.

4.9 Availability of Service

It's also a question of whether or not a certain service or resource that a user need is available in the cloud. If a person tries to visit Google for a search and it is unavailable, they may believe that the internet is down or unavailable. Even if the firm has a large number of data centres and servers, it may fall out of business owing to a lack of services. Multiple cloud computing providers may be the only viable approach, as no single point of failure is permitted.

V. Conclusion

With the progress of technology, everyone expects the best service possible while using the fewest resources possible. Cloud computing is a compelling paradigm for managing and delivering services via the Internet that has just recently developed. Organizations may simply connect to the cloud and use the resources provided on a paper-based basis. This saves the firm money by avoiding the need for extra on-site infrastructure and resources. However, putting Cloud Computing into practise is complex and fraught with difficulties. Unfortunately, there is a scarcity of research that has examined numerous implementation difficulties in a systematic manner.

We have attempted to provide a more thorough knowledge of cloud computing in this work by examining important aspects of cloud computing, deployment techniques, and delivery strategies. Apart from that, one of the primary contributions of this article is the organisation and presentation of critical difficulties and obstacles encountered in the deployment of cloud computing, as well as the presentation of certain methods employed as a solution to these issues. We believe that our research will help people better grasp the difficulties that arise while using cloud computing.

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