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An Analysis of Cloud Computing Technology

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ABSTRACT: ***The way we use computers has changed; almost all desktop applications and data are now kept in the cloud. We're talking about cloud computing, which stores programs and information on a "cloud" made up of thousands of connected computers and servers that can all be accessed online. All of our operations are now web-based rather than desktop-based, thanks to cloud computing. Any machine with an Internet connection may access all of our programs and publications. The cloud computing paradigm is evolving to provide end users with trustworthy, personalized, and QoS-ensured dynamic computing environments. In this study, we aimed to investigate a wide new range of cloud computing services, applications and features This study illustrates to organizations and consumers how cloud computing may provide trustworthy, personalized, and cost-effective services for a variety of applications.***

KEYWORDS: ***Cloud Computing, Virtualization, Data, Infrastructure, Service.***

1. INTRODUCTION

Applications, servers (both physical and virtual), data storage, networking resources, development tools, and other computer resources are each maintained in a remote data center under the control of a cloud services provider (or CSP) and are all made accessible through the Internet. The CSP offers these resources in exchange for a set monthly fee or usage-based fees. According to the cloud services you select, cloud computing can help with the following compared to conventional on-premises IT [1], [2].

1.1. Minor IT costs:

Minor IT costs refer to the smaller expenses incurred in the field of Information Technology (IT) that are relatively low in value or impact compared to major IT expenses. These costs can vary depending on the specific context and requirements of an organization.

1.2. Boost responsiveness and time-to-value:

organizations need to thrive in today's fast-paced business environment. By adopting agile methodologies, organizations can break down complex projects into smaller, manageable tasks, allowing for quicker iterations and faster delivery of value to customers. Cross-functional teams enable collaboration and empower individuals to take ownership, resulting in faster decision-making and streamlined processes. Automation and DevOps practices automate repetitive tasks, enabling frequent software releases and reducing time-to-value [3], [4].

1.3. Scale more easily and affordably:

Scaling easily and affordably is crucial for organizations seeking to meet growing demands while optimizing costs. Cloud computing is a valuable approach as it offers scalable resources on demand, eliminating the need for significant upfront investments in hardware. By leveraging cloud services, organizations can quickly scale their infrastructure to accommodate increased workloads without incurring excessive costs. Another name for the technology that powers the cloud is cloud computing. Indeed, the term "cloud computing" is commonly used to describe the technology that powers the cloud. Cloud computing refers to the delivery of on-demand computing resources, including servers, storage, databases, networking, software, and more, over the Internet. It provides organizations with the flexibility to scale resources up or down as

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needed, access applications and data from anywhere, and pay only for the resources they use [5], [6].

Cloud service providers are companies that offer a wide range of cloud computing services and resources to businesses and individuals. These providers specialize in delivering scalable infrastructure, platforms, and software that enable organizations to leverage the benefits of the cloud. Among the leading cloud service providers are Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP). AWS, a subsidiary of Amazon, offers a comprehensive suite of services, including computing power, storage, databases, analytics, and machine learning. Microsoft Azure provides a robust set of tools and services for building, deploying, and managing applications in the cloud. GCP, offered by Google, offers cloud computing, storage, data analytics, and machine learning services.

2. DISCUSSION

2.1. Types of Cloud services:

The three most prevalent types of cloud services are infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), as well as software-as-a-service (SaaS), and it's not unusual for a business to employ all three. But most of the time, they are unsure of what each of the three comprises:

2.1.1. Infrastructure-as-a-Service (IaaS):

Infrastructure-as-a-Service (IaaS) is a cloud computing model in which a cloud service provider offers virtualized computing resources over the Internet. With IaaS, organizations can access and manage virtualized infrastructure components such as virtual machines, storage, and networking resources on-demand, without the need to invest in and maintain physical infrastructure. In an IaaS model, the cloud service provider is responsible for the underlying hardware, including servers, storage devices, and networking equipment, while the customer has control over the operating systems, applications, and data hosted on the virtualized infrastructure [7]. IaaS has been around since the initial 2010s and was the greatest well-liked cloud computing model at the time, SaaS and PaaS usage is expanding considerably more quickly.

2.1.2. Platform-as-a-Service (PaaS):

Platform-as-a-Service (PaaS) is a cloud computing model in which a cloud service provider offers a platform and environment for developing, deploying, and managing applications. PaaS abstracts the underlying infrastructure and provides a complete development and runtime environment, including operating systems, middleware, development tools, and database management systems. In a PaaS model, developers can focus on building and deploying applications without the need to manage the underlying infrastructure. The cloud service provider handles tasks such as server provisioning, operating system maintenance, and scalability, allowing developers to concentrate on coding and application logic. Containers are a kind of virtualized computing that varies from virtual servers and are often used to create PaaS. Programmers may bundle a program with only the operating system features required for it to execute on any platform without modification or the requirement for middleware since the operating system is virtualized via the usage of containers. Built on Docker containers and Kubernetes, an open-source container orchestration technology that automates the deployment, scaling, load balancing, and other operations associated with container-based applications, Red Hat Open Shift is a well-known PaaS provider [8].

2.1.3. Software-as-a-Service (SaaS):

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Software-as-a-Service (SaaS) is a cloud computing model in which software applications are delivered over the internet on a subscription basis. With SaaS, users can access and use software applications hosted by a cloud service provider without the need to install or manage the software on their local devices. In the SaaS model, the cloud service provider is responsible for maintaining and managing the underlying infrastructure, including servers, databases, and network resources. Users access the software application through a web browser or a dedicated client application, typically paying a recurring subscription fee based on usage or the number of users. Along with the cloud's cost reductions, quicker time to value, and scalability advantages, SaaS provides the following:

2.1.4. Automatic Updates:

SaaS users do not need to organize an on-premises upgrade since they get new features immediately as the provider makes them accessible.

2.1.5. Stopping Data Loss:

You won't lose everything regardless of whether your device malfunctions or stops operating since your application data is stored in the cloud. There are several SaaS options, including departmental and industry-specific applications, powerful corporate software databases, and AI (artificial intelligence) tools. Currently, SaaS is the preeminent method of software delivery for the vast majority of commercial applications [9].

2.1.6. Serverless Computing:

Serverless computing, also known as Function as a Service (FaaS), is a cloud computing model that enables developers to focus solely on writing and deploying functions or snippets of code, without the need to manage or provision servers or infrastructure. In serverless computing, cloud service providers handle the underlying infrastructure, automatically allocating resources to run code in response to events or function invocations. One of the key features of serverless computing is event-driven execution. Functions are triggered by specific events or requests, such as HTTP requests, database updates, file uploads, or scheduled tasks. They are executed only when needed, reducing idle time and optimizing resource utilization. This event-driven architecture allows for efficient and scalable execution of code, as resources are provisioned dynamically based on demand. FaaS is often mistaken for serverless computing, however serverless is a subset of it. To launch functions sections of application code in reply to certain triggers, developers may utilize FaaS. The cloud service provider manages the virtual machine operating system, actual hardware, and web server software all in real time while the code is executed and shuts down once it is finished. Billing starts and stops at the same time as execution [10].

2.2. Categories of Cloud Computing:

2.2.1. Public Cloud:

Public cloud refers to a type of cloud computing infrastructure that is owned and operated by third-party service providers and made available to the general public over the Internet. In the public cloud model, multiple organizations and individuals share the same pool of computing resources, including virtual machines, storage, and applications, hosted in the provider's data centers. One of the key characteristics of the public cloud is its scalability and elasticity. Public cloud providers can rapidly allocate and scale computing resources based on demand. This allows organizations to quickly and easily expand or contract their infrastructure as needed, accommodating fluctuating workloads and ensuring optimal performance.

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Another advantage of the public cloud is the cost-efficiency it offers. Rather than investing in and maintaining their physical infrastructure, organizations can leverage the shared resources of the public cloud provider. They pay for the computing resources they consume on a pay-as-you-go or subscription basis, allowing for more predictable and flexible cost management. The public cloud also provides a high level of accessibility and convenience. Users can access their applications, data, and services from any location with an internet connection, using a variety of devices. This flexibility enables remote work, collaboration, and easy access to resources without the constraints of physical infrastructure or location. Because the public cloud is adaptable and elastic, many firms are moving portions of their computer infrastructure there. This allows them to respond to changing workload requirements. Others are drawn by the prospect of greater productivity and less resource waste as a result of customers only paying for what they use. Some people want to save money on equipment and on-site infrastructure.

2.2.2. Private Cloud:

A private cloud refers to a cloud computing infrastructure that is dedicated to a single organization or entity and is not shared with other organizations. In a private cloud, the computing resources, including servers, storage, and networking, are provisioned and maintained on-premises or in a dedicated data center. One of the key advantages of a private cloud is enhanced security and control. Organizations have complete control over their data and infrastructure, allowing them to implement stringent security measures and customize their cloud environment to meet specific compliance requirements and security standards. This level of control is especially critical for industries with strict data privacy regulations or sensitive information. Another benefit of a private cloud is increased reliability and performance. By having exclusive access to computing resources, organizations can allocate resources based on their specific needs and ensure consistent performance for their applications and services. This is particularly beneficial for workloads that require high availability, low latency, and predictable performance. Private clouds also offer greater flexibility and customization options compared to public clouds. Organizations can tailor the cloud infrastructure to their specific requirements, including hardware configurations, network setups, and software stack. This allows for seamless integration with existing on-premises systems and legacy applications, providing a unified and cohesive IT environment.

2.2.3. Hybrid Cloud:

A hybrid cloud refers to a cloud computing environment that combines the use of both private and public clouds, allowing organizations to leverage the benefits of both deployment models. In a hybrid cloud, the private and public cloud environments are connected, enabling data and application portability between them. The key characteristic of a hybrid cloud is its flexibility and the ability to address specific needs and requirements. Organizations can choose to keep sensitive data and critical workloads in the private cloud, taking advantage of its enhanced security and control. At the same time, they can leverage the scalability and cost-effectiveness of the public cloud for non-sensitive workloads or to handle peak demand periods.

2.2.4. Multi-Cloud & Hybrid Multi-Cloud:

Multi-cloud refers to the use of multiple public cloud service providers to meet different needs within an organization. Instead of relying on a single cloud provider, organizations choose to distribute their workloads and applications across multiple cloud platforms. This approach allows organizations to take advantage of the unique features, capabilities, and pricing models offered by different cloud providers. It also provides resilience and avoids vendor lock-in, as organizations are not dependent on a single provider for all their cloud services. Hybrid multi-

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cloud takes the concept of multi-cloud a step further by combining public cloud services from multiple providers with private cloud infrastructure. In a hybrid multi-cloud environment, organizations have the flexibility to deploy workloads and applications across private and public clouds based on their specific requirements. This allows organizations to maintain control over sensitive data and critical applications in the private cloud while leveraging the scalability and cost-effectiveness of public cloud services for other workloads. Hybrid multi-cloud offers a balance between customization, security, and scalability, providing organizations with greater flexibility and choice.

2.3. Cloud Security:

Cloud security refers to the practices, technologies, and policies designed to protect data, applications, and infrastructure within cloud computing environments. As organizations increasingly rely on cloud services to store and process their data, ensuring robust security measures becomes crucial to safeguarding sensitive information and maintaining the privacy and integrity of cloud-based resources.

According to safety software provider McAfee (the source is external to IBM), 52% of businesses presently experience greater privacy in the cloud compared to on-premises workloads in a cloud infrastructure as a kind of service is expected to have 60% fewer security risks by 2020 than traditional data centers, according to Gartner (PDF, 2.3 MB). But unlike in conventional IT environments, cloud security requires various protocols and worker skill sets. Here are some recommendations for cloud security best practices:

- **Shared duty for security**: In general, customers are responsible for preserving their data inside the cloud, while cloud providers are in charge of protecting the cloud infrastructure. It is critical to identify who owns particular data between both public and private third parties.
- **Data encryption**: Data encryption is a fundamental security measure used to protect sensitive information stored or transmitted in cloud computing environments. It involves converting plaintext data into ciphertext using encryption algorithms, making the data unreadable and unusable without the appropriate decryption key.
- **Controlling user identification and access**: Network, device, application, and data access should be completely visible to customers and IT teams.
- **Collaboration in management**: Collaboration in management refers to the process of working together and sharing knowledge, resources, and responsibilities among individuals and teams to achieve common goals and drive organizational success.
- **Keeping an eye on compliance and security**: Keeping an eye on compliance and security is a critical aspect of effective management in today's business landscape. Compliance refers to adhering to relevant laws, regulations, and industry standards, while security focuses on safeguarding sensitive information, protecting against unauthorized access, and mitigating risks. There is also continual monitoring of all related systems and cloud-based services.

2.4. Cloud computing uses cases:

Cloud platforms provide the ability to quickly deploy and scale applications based on demand. Organizations can easily spin up or down virtual servers and storage resources to match their current needs, ensuring optimal performance and cost-efficiency. Cloud storage services offer secure and reliable data storage options. Organizations can store their data in the cloud, eliminating the need for on-premises storage infrastructure and reducing the risk of data loss.

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Cloud backups provide an additional layer of protection against data breaches or hardware failures. Cloud computing allows organizations to establish robust disaster recovery and business continuity strategies. By replicating data and applications to geographically dispersed cloud servers, businesses can quickly recover from disasters and continue operations with minimal downtime. Anything that involves quickly storing and processing large volumes of data and requires more computing and storage capacity than the majority of organizations can or want to create on-premises is the target of cloud computing. Here are some examples:

1. Big data analytics
2. The Internet of Things (IoT).
3. Artificial intelligence, applications for machine learning and deep learning in particular.

3. CONCLUSION

In this review article, there is discussed the definition, categories, and elements of cloud computing along with several cloud computing methodologies. The range of applications for cloud computing continues to grow. Today, almost all small and big businesses employ cloud computing to manage their infrastructure, traffic, and storage needs. It is clear from this that cloud computing has a big impact on society and businesses. The cloud provides rapid end-user self-service that prevents operational duties, such as setting up testing and development computer systems, from becoming hurdles in the development procedure for development teams using Agile or DevOps (or DevSecOps) to expedite development.

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