AISSMS

COLLEGE OF ENGINEERING

Approved by AICTE, New Delhi, Recognized by
Govt. of Maharashtra, Affiliated to Savitribai Phule Pune University
and recognized 2(f) and 12(B) by UGC (Id.No. PU / PN/ Engg. / 093 (1992)
Accredited by NAAC with 'A+' Grade

A Seminar Report On

Cloud Computing

Submitted in partial fulfilment of the requirements for the degree of

BACHELOR OF ENGINEERING

In

COMPUTER ENGINEERING

Submitted by

Name of Student :Dhiraj Vishnu Jagdale

Roll no : 23CO054

Under the Guidance of

Prof. S P Warkari

Department Of Computer Engineering

ALL INDIA SHRI SHIVAJI MEMORIAL SOCIETY'S

COLLEGE OF ENGINEERING

Pune – 411001

Academic Year: 2025-26(Term – I)

Savitribai Phule Pune University

AISSMS
COLLEGE OF ENGINEERING
Approved by AICTE, New Delhi, Recognized by
Govt. of Maharashtra, Affiliated to Savitribai Phule Pune University
and recognized 2(f) and 12(B) by UGC (Id.No. PU / PN/ Engg. / 093 (1992)
Accredited by NAAC with 'A+' Grade

ALL INDIA SHRI SHIVAJI MEMORIAL SOCIETY'S COLLEGE OF ENGINEERING DEPARTMENT OF COMPUTER ENGINEERING

CERTIFICATE

This is to certify that **Dhiraj Vishnu Jagdale** from **Third Year Computer Engineering** has successfully completed his seminar work titled "**Cloud Computing**" at AISSMS College of Engineering, Pune in the partial fulfilment of Bachelor's Degree in Engineering.

Prof. S P Warkari	Dr. S.V. Athawale	Dr.D.S. Bormane
Seminar Guide	HOD	Principal
		AISSMS COE, Pune

SEMINAR APPROVAL

The Seminar entitled

Cloud Computing

By

Dhiraj Vishnu Jagdale

(23CO054)

Is approved for the degree of

Bachelor of Engineering

In

Computer Engineering

Examiner 1	Examiner 2
Name and Signature	Name and Signature

Date:

Place:

ABSTRACT

The traditional approach to information technology (IT) infrastructure has involved significant upfront investment in hardware, software, and maintenance. This model presents challenges in scalability, cost management, and agility. Cloud Computing emerges as a paradigm shift, addressing these limitations by delivering IT resources—such as servers, storage, databases, and software—on-demand over the internet with pay-as-you-go pricing.

Cloud Computing has drawn increasing attention as one of the most transformative technologies of our time due to its high efficiency, scalability, and cost-effectiveness. It abstracts the complex underlying infrastructure from the end-user, allowing businesses to focus on innovation rather than on managing hardware.

This report explores the fundamental concepts of Cloud Computing, including its essential characteristics and core service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). It delves into the various deployment models, such as public, private, and hybrid clouds. The underlying technologies that enable the cloud, primarily virtualization and containerization, are discussed. Furthermore, the report examines the advantages, challenges, and vast applications of cloud technology, from simple web hosting to complex AI and Big Data analytics, providing a comprehensive overview of its impact on the digital landscape.

ACKNOWLEDGEMENT

It gives me a great pleasure to acknowledge the contribution of all those who have directly or indirectly contributed to the completion of this seminar.

I express my foremost and deepest gratitude to my guide **Prof. S. P. Warkari** for his supervision, noble guidance and constant encouragement in carrying out the seminar.

I am deeply indebted to **Dr. S V Athawale**, Head, Computer Engineering Department for his time- to-time advice and support and also for providing all the necessary facilities available in the Institute.

Acknowledgement will not be completed if I forget to mention special thanks to all the teaching and non-teaching staff of Computer Engineering Department for rendering support directly or indirectly.

Academic Year: 2025-26

Date-

Table of Contents

List of Figures

1. INTRODUCTION TO MODERN IT INFRASTRUCTURE

.1 Introduction

In the digital age, information technology (IT) is the backbone of nearly every business operation. The infrastructure that supports this technology—comprising servers, storage, networking components, and software—is critical for innovation, customer service, and growth. For decades, the standard approach was for organizations to own and manage their entire IT stack in-house.

However, as the pace of business has accelerated, this traditional model has shown significant limitations. The need for greater flexibility, faster deployment times, and more efficient cost structures has driven the search for a new paradigm in IT infrastructure delivery.

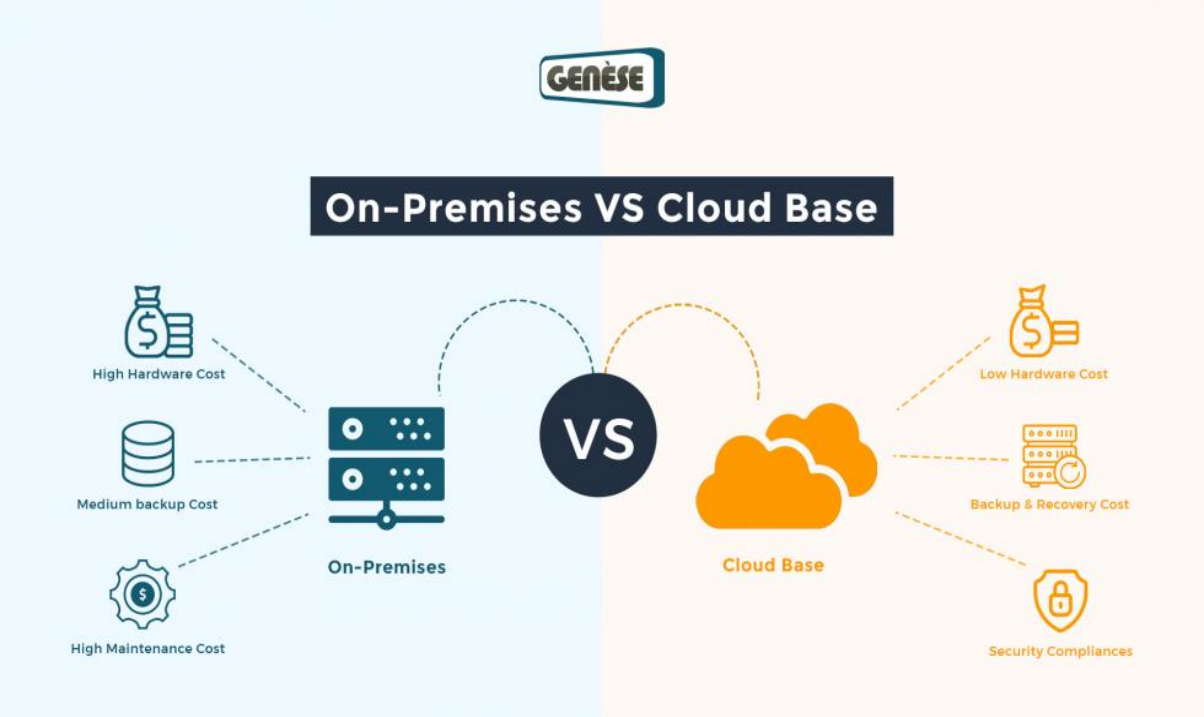
Cloud computing represents this new paradigm. It has evolved from concepts like grid computing and utility computing to become the dominant model for delivering IT services. Instead of owning computing infrastructure, companies can now access it as a service from a cloud provider, much like tapping into the public electricity grid.

1.2 The Traditional On-Premises Model

The traditional "on-premises" model requires a business to purchase, install, and manage its own servers and software in its own data center. This approach involves:

- **High Capital Expenditure (Capex):** Large upfront investments are needed to buy hardware and software licenses.

- **Long Procurement Cycles:** Acquiring and setting up new hardware can take weeks or months.
- **Capacity Guesswork:** Companies must over-provision resources to handle peak demand, leading to wasted capacity during normal operations.
- **Maintenance Overhead:** A dedicated IT team is required for hardware maintenance, software patching, and security.



These factors make it difficult for businesses, especially startups, to scale quickly and respond to market changes.

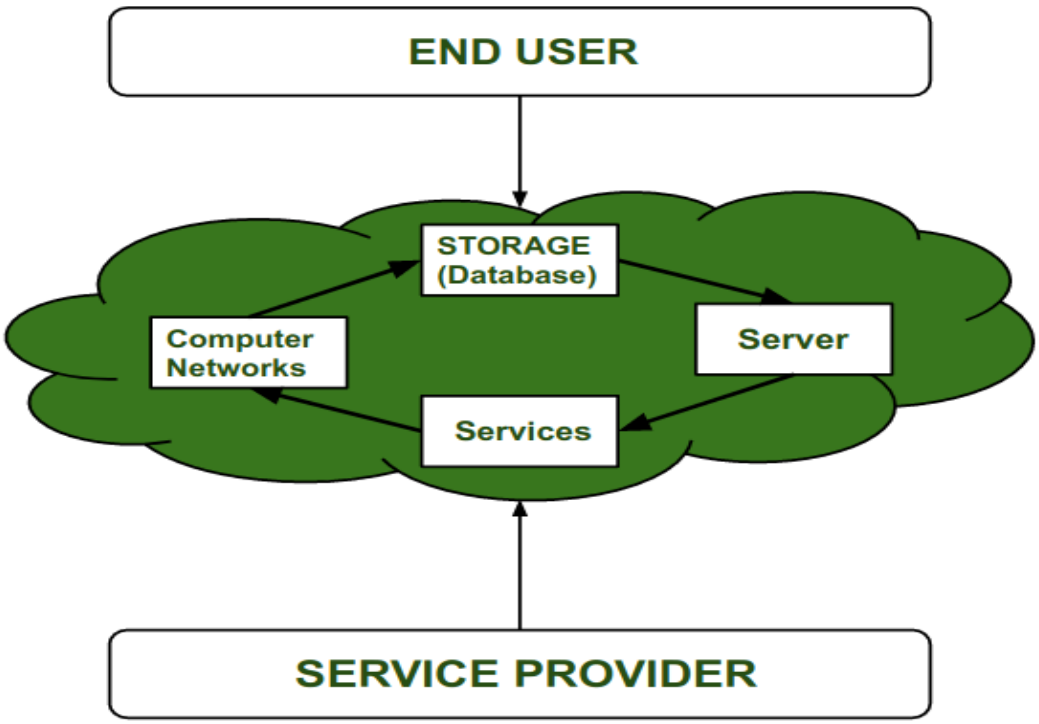
1.3 The Emergence of Cloud Computing

Cloud computing directly addresses the shortcomings of the on-premises model. It offers a fundamentally different approach:

- **Operational Expenditure (Opex):** Eliminates upfront costs by converting them to a variable, pay-as-you-go operating expense.

- **Agility and Speed:** New resources can be provisioned in minutes, allowing for rapid development and deployment.
- **Elasticity:** Services can automatically scale up to handle spikes in traffic and scale down to save costs.
- **Managed Service:** The cloud provider handles the underlying hardware maintenance, allowing businesses to focus on their core applications.

This shift has democratized access to enterprise-grade IT infrastructure, enabling innovation at an unprecedented scale.



2. THEORETICAL BACKGROUND & LITERATURE REVIEW

2.1: Overview

The concepts underpinning cloud computing did not appear overnight but evolved over decades of research in virtualization, distributed computing, and service-oriented architecture. The journey from massive, centralized mainframes to the ubiquitous, decentralized cloud has been driven by the relentless pursuit of more efficient, scalable, and accessible computing power.

Virtualization, the technology that allows a single physical machine to run multiple virtual machines, is the key enabler. By abstracting the software from the hardware, virtualization allows for the resource pooling and rapid elasticity that define the cloud. Early research in this area laid the groundwork for today's hypervisors.

Furthermore, the development of reliable, high-speed internet connectivity was crucial. It transformed the network from a simple communication tool into a platform for delivering complex services. Researchers have focused on improving the accuracy, efficiency, and security of these distributed systems, making the cloud a robust platform for enterprise applications.

2.2 Literature Review:

The following table reviews some of the foundational concepts and papers that have shaped the field of cloud computing.

Title and Authors	Journal/ Conference	Publication Year	Topic Reviewed/ Methodology	Key Contribution
The NIST Definition of Cloud Computing P. Mell, T. Grance	NIST Special Publication	2011	Provides the standardized definition and lists the 5 essential characteristics, 3 service models, and 4 deployment models.	**Advantage:** Created a common vocabulary and framework for understanding the cloud
On the Design, Use, and Deployment of Virtual Machines C.A. Waldspurger	VMWare / ACM	2002	Details the principles of virtualization that enable efficient server consolidation and resource management.	**Advantage:** Foundational for IaaS, allowing hardware to be treated as a utility. **Disadvantage:** Early VMs had performance overhead.

MapReduce: Simplified Data Processing on Large Clusters J. Dean, S. Ghemawat	Google / OSDI	2004	Introduces a programming model for processing large data sets in a parallel, distributed manner on clusters of commodity hardware.	**Advantage:** Revolutionized big data processing and is a core component of many cloud-based data services.
A View of Cloud Computing M. Armbrust, A. Fox, et al.	Communications of the ACM	2010	An influential paper from UC Berkeley that defines cloud computing from an academic perspective and outlines the top 10 obstacles and opportunities	**Advantage:** Provided a clear academic roadmap for cloud research. **Disadvantage:** Some predictions are now dated.

3. CORE ARCHITECTURE AND METHODOLOGY

3.1 Principle: The 5 Essential Characteristics

The National Institute of Standards and Technology (NIST) defines cloud computing through five essential characteristics that distinguish it from traditional hosting. These principles are the foundation of any true cloud service.

1. **On-Demand Self-Service:** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

2. **Broad Network Access:** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

3. **Resource Pooling:** The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.

4. **Rapid Elasticity:** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities

available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

5. **Measured Service:** Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

3.2 Cloud Architecture: Service & Deployment Models

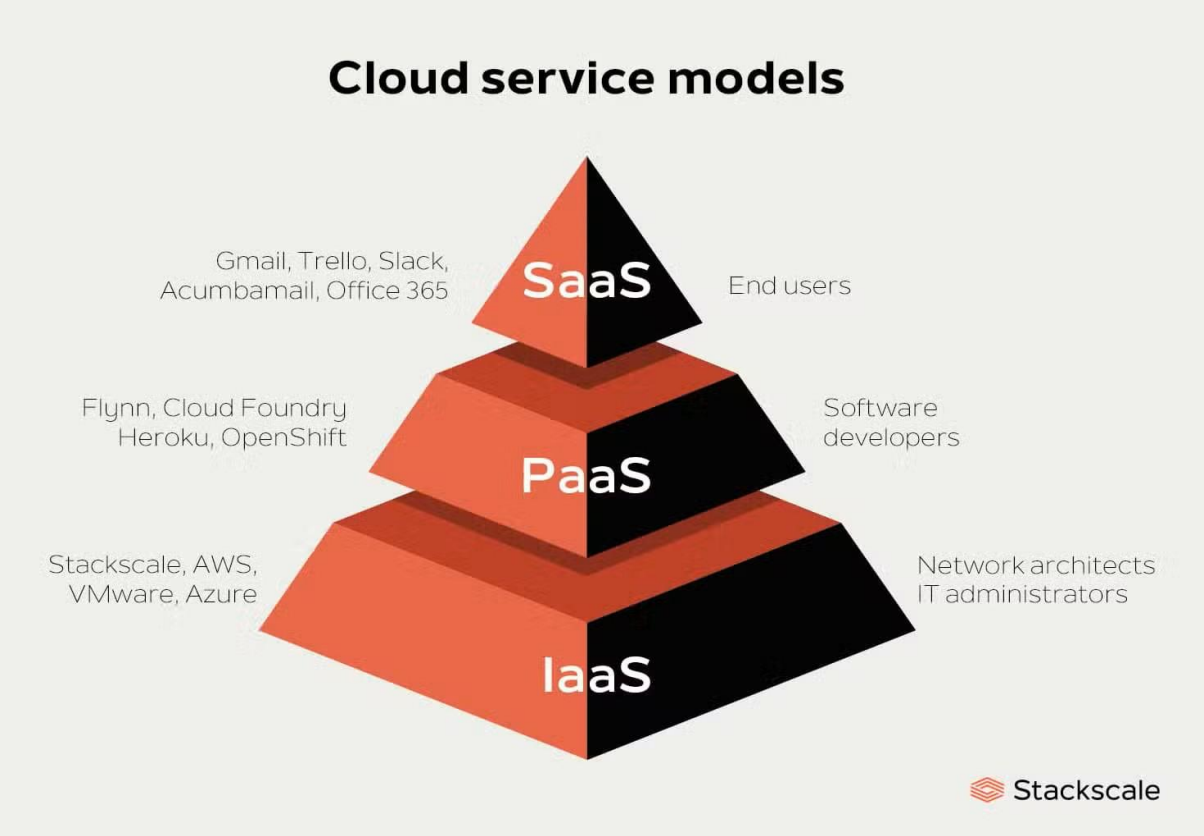
The architecture of cloud computing is defined by how services are offered (**Service Models**) and where the infrastructure is located (**Deployment Models**).

Service Models

This describes the different layers of service that can be rented from a cloud provider.

- **Infrastructure as a Service (IaaS):** The most basic category. The provider offers fundamental computing resources like virtual machines, storage, and networking. The user manages the operating system and applications.
- **Platform as a Service (PaaS):** Provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app.

- **Software as a Service (SaaS):** Delivers ready-to-use software over the internet on a subscription basis. The provider manages the hardware, middleware, application software, and security.



Deployment Models

This describes the environment in which the cloud services are deployed.

- **Public Cloud:** The cloud infrastructure is provisioned for open use by the general public. It is owned, managed, and operated by a business, academic, or government organization.
- **Private Cloud:** The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers. It may be owned, managed, and operated by the organization, a third party, or some combination of them.

- **Hybrid Cloud:** A composition of two or more distinct cloud infrastructures (private or public) that remain unique entities but are bound together by standardized technology that enables data and application portability.
- **Multi-Cloud:** The use of multiple cloud computing services from more than one cloud provider in a single heterogeneous architecture.

3.3 Working: A Cloud Service Request Lifecycle

The process of provisioning a resource in the cloud is highly automated and follows a clear lifecycle, managed by the cloud provider's control plane.

1. **User Request:** A user initiates a request to create a resource (e.g., a virtual machine) via a web console, Command-Line Interface (CLI), or an Application Programming Interface (API) call.
2. **Authentication & Authorization:** The cloud's Identity and Access Management (IAM) service verifies the user's identity and checks if they have the necessary permissions to create the requested resource.
3. **Request Scheduling:** The control plane accepts the validated request and determines the best physical hardware in its data center to host the new resource, considering factors like available capacity and geographic location.
4. **Resource Provisioning:** The control plane instructs the hypervisor on the chosen physical server to create and configure the virtual machine according to the user's specifications (CPU, RAM, storage). The network is configured to provide an IP address and apply security rules.
5. **Resource Activation:** Once the VM is running and accessible over the network, the control plane updates its state to "active" and returns the connection details (e.g., IP address) to the user.
6. **Monitoring & Metering:** From the moment the resource is active, the cloud platform begins monitoring its performance and metering its usage for billing purposes.

This entire process, which would take weeks in a traditional model, is typically completed in seconds or minutes in the cloud.

4.FEATURES/ADVANTAGES/APPLICATIONS/OPPORTUNITY & CHALLENGES

4.1 Key Features of Cloud Computing:

- **Global Scale:** Instantly deploy applications in multiple geographic regions around the world.
- **Reliability & High Availability:** Cloud providers offer built-in redundancy across multiple data centers, ensuring high uptime.
- **Security:** Providers offer a deep set of security controls, policies, and technologies to strengthen an organization's security posture.
- **Programmable Infrastructure:** Resources can be managed and provisioned through code (Infrastructure as Code - IaC), enabling automation and consistency.

4.2 Advantages of Cloud Computing:

- **Cost Savings:** Eliminates the need for capital expenditure on hardware and reduces operational costs for power, cooling, and IT staff.
- **Speed and Agility:** Reduces the time to make IT resources available from weeks to minutes, drastically increasing business agility.
- **Focus on Business Value:** By offloading infrastructure management, companies can focus their engineering talent on developing applications that create business value.
- **Enhanced Collaboration:** Cloud-based applications allow teams to access, edit, and share documents and projects from anywhere, at any time.

4.3 Applications of Cloud Computing:

Cloud technology is versatile and powers a vast array of applications across every industry.

- **Application Hosting:** From simple websites to complex enterprise applications.
- **Data Storage, Backup, and Recovery:** Cost-effective and scalable solutions for storing data and ensuring business continuity.
- **Big Data Analytics:** Provides the massive computational power needed to process and analyze terabytes of data.
- **Artificial Intelligence and Machine Learning (AI/ML):** Offers on-demand access to powerful GPUs and specialized AI services for training and deploying models.
- **Internet of Things (IoT):** Provides the backend infrastructure to connect, manage, and analyze data from millions of IoT devices.
- **Software Development and Testing:** Create and dismantle development environments quickly and affordably.

4.4 Opportunity and Challenges:

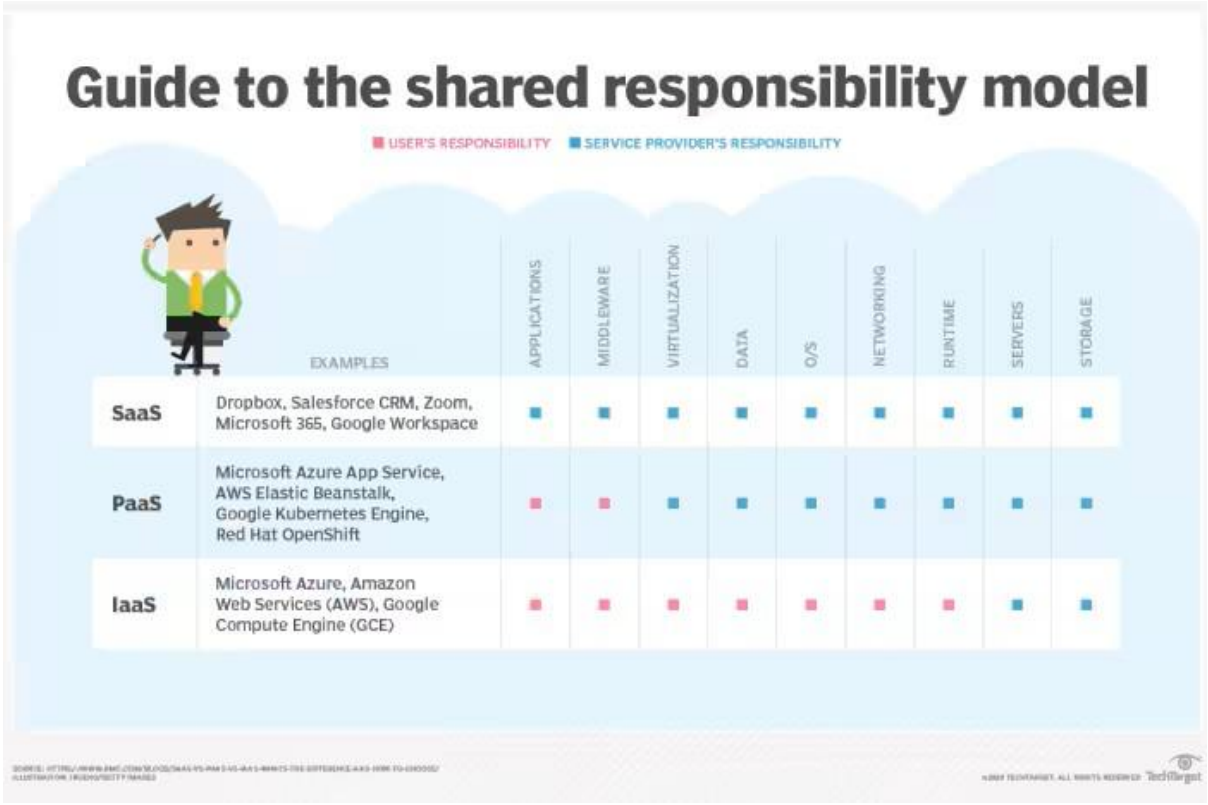
Opportunity - Innovation: The cloud is a platform for innovation, enabling the rapid development of new technologies like serverless computing and quantum computing.

Challenge - Security: While providers offer robust security, customers are ultimately responsible for securing their data and applications in the cloud. This is governed by the **Shared Responsibility Model**.

Challenge - Cost Management (FinOps): The pay-as-you-go model is a double-edged sword. Without proper monitoring and governance, costs can spiral out of control.

Challenge - Vendor Lock-in: Migrating applications and data from one cloud provider to another can be complex and costly, making businesses dependent on a single vendor.

Challenge - Complexity: Managing a large-scale cloud environment requires specialized skills in areas like cloud architecture, security, and automation.



5. FUTURE SCOPE

Cloud computing is not a static technology; it is constantly evolving. The future scope is vast, with several key trends shaping the next generation of cloud services.

- **Serverless Computing (FaaS):** The evolution beyond containers, where developers deploy code as individual functions without managing any underlying infrastructure. This model offers ultimate scalability and cost-efficiency, as you only pay for the exact execution time.
- **Edge Computing:** As IoT devices proliferate, there is a growing need to process data closer to where it is generated (the "edge") rather than sending it to a centralized cloud. This reduces latency and bandwidth usage. Future cloud architectures will seamlessly integrate the central cloud with a distributed network of edge locations.
- **AI and Machine Learning Platforms:** Cloud providers are moving beyond offering raw computing power for AI to providing comprehensive, managed platforms (AI PaaS). These platforms will simplify the entire ML lifecycle, from data preparation and model training to deployment and monitoring, making AI accessible to more organizations.
- **Quantum Computing:** While still in its infancy, major cloud providers are beginning to offer access to quantum computers via the cloud. This will democratize access to this revolutionary computing paradigm, enabling breakthroughs in fields like medicine, materials science, and finance.
- **Hybrid and Multi-Cloud Management:** As more organizations adopt hybrid and multi-cloud strategies, the demand for sophisticated tools

that can manage resources, security, and costs across multiple environments from a single control plane will grow significantly.

7. CONCLUSION

Cloud computing has fundamentally reshaped the landscape of information technology, moving it from a capital-intensive, product-based model to a flexible, service-oriented paradigm. Its core principles of on-demand access, scalability, and pay-as-you-go pricing have democratized access to enterprise-grade infrastructure, fueling innovation across industries.

This report has detailed the journey from the rigid traditional IT model to the agile cloud ecosystem. We have explored the essential characteristics, the layered service models (IaaS, PaaS, SaaS), and the versatile deployment options (Public, Private, Hybrid) that define the cloud.

While the advantages in cost, speed, and scale are compelling, successful cloud adoption requires addressing significant challenges, particularly in security, cost governance, and complexity. The Shared Responsibility Model is a critical concept, emphasizing that security is a partnership between the provider and the customer.

7. REFERENCES

[1] Mell, P., & Grance, T. (2011). *The NIST Definition of Cloud Computing* (Special Publication 800-145). National Institute of Standards and Technology.

[2] Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., ... & Zaharia, M. (2010). A view of cloud computing. *Communications of the ACM, 53*(4), 50-58.

[3] Amazon Web Services. (2022). *Shared Responsibility Model*. AWS Documentation.

[4] Dean, J., & Ghemawat, S. (2008). MapReduce: simplified data processing on large clusters. *Communications of the ACM, 51*(1), 107-113.

[5] Vaquero, L. M., Rodero-Merino, L., Caceres, J., & Lindner, M. (2008). A break in the clouds: towards a cloud definition. *ACM SIGCOMM Computer Communication Review, 39*(1), 50-55.

[6] Chappell, D. (2008). *A Short Introduction to Cloud Platforms*. David Chappell & Associates.