Chapter 1
Fundamental Concepts of Cloud Computing

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ABSTRACT

Cloud computing has transformed corporate and consumer lives. Cloud computing may save startups and businesses money and improve services. Independent developers may build global apps and services, share, and analyze data at scales formerly reserved for well-funded projects. Internet users may quickly create, share, and preserve digital content beyond their devices' computing capabilities. The cloud provider owns and maintains computer resources in cloud computing. Browser-based apps like Netflix, third-party data storage for images and other digital files like iCloud or Dropbox, and third-party servers used to support a company, research, or personal project's computer architecture are examples of such resources. This chapter discusses many topics related to cloud computing, such as: Cloud computing term, entities, technologies, delivery models, environments, and platforms, advantages and disadvantages of cloud computing, benefits of cloud computing, using cloud computing, risks and security concerns, cloud computing ethics, challenges, and costs, and research directions.

INTRODUCTION

The impact of cloud computing on industries and end users is of significant magnitude, as the extensive utilization of cloud-based applications has resulted in the transformation of various aspects of everyday life. Cloud computing offers startups and companies the opportunity to reduce costs and enhance their service offerings by eliminating the need to procure and manage hardware and software internally. Individual developers possess the autonomy to create internet services and software applications that are universally accessible. The advancements in data sharing and analysis have facilitated the ability to conduct research on a larger scale, which was previously limited to projects with substantial funding. Furthermore, individuals utilizing the internet have the convenient ability to access software applications and storage systems, enabling them to create, disseminate, and store digital content in quantities that surpass the limitations of their personal computer devices.

Cloud computing refers to the allocation of computer resources as a service, wherein the responsibility for ownership and management of these resources lies with the cloud provider, rather than the end user. These resources encompass a wide range of options, including web-based software programs such as TikTok or Netflix, as well as third-party data storage solutions like iCloud or Dropbox. Additionally, third-party servers are utilized to provide support for the computing infrastructure of various entities, including companies, research projects, or personal endeavors.

To cultivate innovation, the National Institute of Standards and Technology (NIST), an independent agency under the jurisdiction of the United States Department of Commerce, provides the following definition of cloud computing (Mell & Grance, 2011):

This statement describes a conceptual framework that facilitates widespread and easily accessible network connectivity, allowing users to access a shared collection of adaptable computing resources. These resources may include networks, servers, storage, applications, and services. The provisioning and release of these resources can be done quickly and with minimal involvement from the user or service provider.

- ***On-demand self-service***: Cloud resources can be accessed or provisioned without the need for human intervention. Customers have the option to enroll in this particular model, which grants them immediate access to cloud services. Furthermore, organizations have the capability to establish operational frameworks that facilitate the seamless utilization of internal cloud services by employees, customers, or collaborators, in alignment with predetermined protocols, thereby eliminating the need for IT support.
- ***Broad network access*** enables users to securely access cloud services and resources from any networked location and any authorized device.
- ***Resource pooling*** refers to the practice of maintaining the privacy of individual customers' data from other clients, while simultaneously allowing multiple tenants to utilize resources provided by the cloud provider.
- ***Quick elasticity:*** In contrast to hardware and software deployed on-site, cloud computing resources possess the ability to swiftly and flexibly increase, decrease, or modify in accordance with the evolving requirements of the cloud user.
- ***Metered service***: The utilization of cloud resources is measured, enabling companies and other cloud customers to solely incur charges for the specific resources they actively utilize within a designated billing cycle.

These characteristics offer both organizations and individuals a wide range of transformative possibilities. Before the ubiquitous adoption of cloud computing, organizations and individual computer users frequently had to procure and uphold the software and hardware they intended to employ. Due to the increasing prevalence of cloud-based applications, storage, services, and devices, both businesses and individuals now have the opportunity to utilize a diverse range of on-demand computing resources that are accessible through internet-based platforms. The adoption of cloud services has relieved users from the need to invest significant time, financial resources, and expertise in procuring and overseeing computing resources. This transition has occurred as organizations have moved away from on-premise software and hardware towards utilizing networked resources that are geographically distant. The advent of widespread access to computing resources has given rise to a novel cohort of cloud-based enterprises. This development has not only brought about significant changes in IT practices across various industries

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