

Review Paper on Cloud Computing Security and Privacy

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ABSTRACT

Cloud computing technology is used in the IT industry, and privacy security issues concern organizations and institutes. Many academia government sectors business enterprise sectors adopted cloud computing. We have reviewed talk about Security & privacy in cloud Computing and we have reviewed Privacy & Security. First, we introduce some security privacy risks of cloud computing and propose a confidential privacy security framework. Second, we discuss the research progress of several techniques such as access control. We evaluate the potential threats to computers by unauthorized access and evaluate the challenges to user trust and data integrity within cloud infrastructure. We also work on the security and risks of cloud computing and propose and discuss strategies and solutions to protect user privacy. It's internet-dependent technology, cloud computing stores and manages data in the data centre of a cloud provider, such as Google, Amazon, Microsoft, IBM, etc. In this review article, I have provided a summary of cloud computing by analyzing 30 different articles on cloud computing security and privacy. The study results of the review paper reveal the status of organizations in the IT industries before and after that the challenges and possible future direction in cloud computing.

Keywords: cloud, cloud computing, IAAS, PAAS, privacy security, SaaS.

Introduction

Cloud computing is the on-demand access and sending of computing resources with pay-as-you-go price determination. It is thought that Joseph Carl Robnett Licklider invented cloud computing in the 1960s by working on ARPANET to link people and data from any location at any time. In 1983, CompuServe presented its users with a small amount of disk space that could be used to accumulate any files they uploaded (Mrs. Ashwini S., Mr. Sachin B., Mr. Harshad K., et al., 2021). Cloud computing, the next stage of the internet's development, offers the means by which everything from commercial operations to personal collaboration to processing power is made available to you as a service at any time and where you require it (Ahmed S., A., Dhanush A., M., et al., 2022).

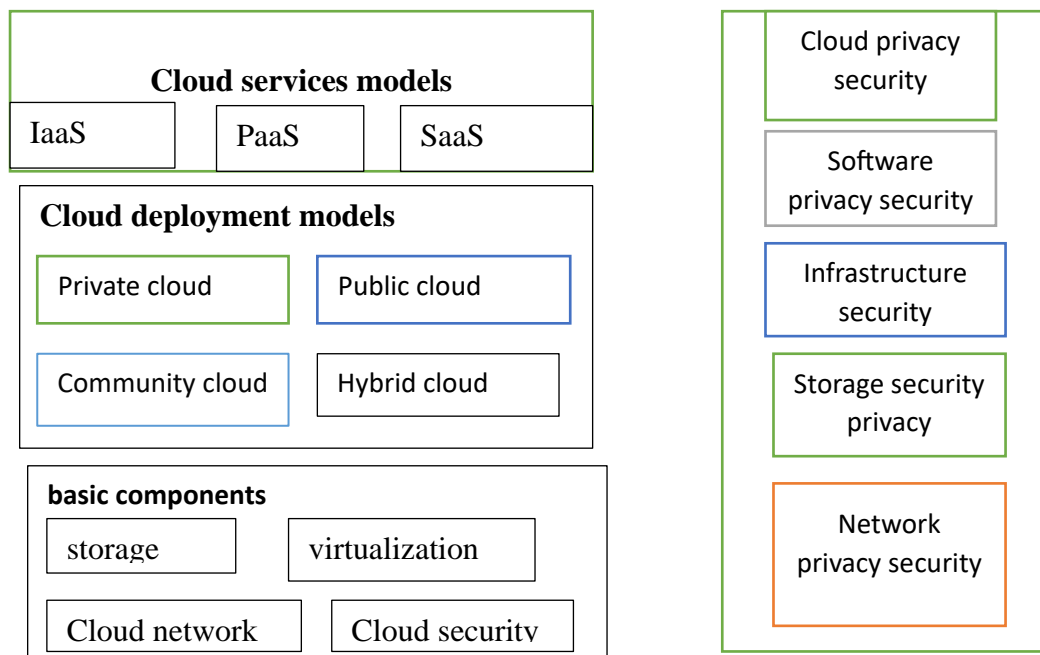
Basic concepts of cloud computing

Cloud computing as a term for this internet-based service was introduced in late 2006 by industry giants such as Google Cloud and Amazon Cloud. This is due to fewer employees and consequently lower costs, as projected by market research firm IDC. The IT cloud computing service market will grow from around US\$16 million in 2008 to US\$42 million by 2012 but will reach US\$800 million in 2024. A 20.5% growth is expected in 2023 and a similar increase in 2025, while the growth rate will slow slightly in the forecast period. The market is still

projected to deliver a 5-year growth rate of 19.5%. Worldwide revenue will reach \$1.6 trillion in 2028 (Shirer, 2024). Reduced the hardware and software requirements on a user site. To do this we need cloud computing and all we need is a browser. For cloud computing, we all need a web browser like Chrome (Priyanshu S., Rizwan K., et al., 2018). Follows the key elements of cloud computing:

- I.I Resource Pooling and Elasticity
- I.II Self-Service and On-Demand Services
- I.III Pricing
- I.IV Quality of Service

Cloud computing offers 3 services and four deployment models which are Software as a Service, Platform as a Service and Infrastructure as a Service, private cloud, public cloud, hybrid cloud, and community cloud (Sun, P., J., et al, 2020).



Cloud computing the unique benefits and features each model offers, businesses can successfully utilize cloud technology. To make informed decisions on their cloud strategy, businesses need to be aware of these models (Kavita A. Sultanpure & L. S. S. Reddy, et al., 2019).

Infrastructure as a service that provides online access to virtualized computer resources. Users can optimize expenses by scaling up or down infrastructure as per demand. Such as Google Cloud Compute and Amazon EC2, which let customers handle networking and storage without worrying about the actual hardware (Kavita A. Sultanpure & L. S. S. Reddy, et al., 2019; Pragya, Devi, et al., 2024).

Platform as a Service (PaaS) provides a platform that allows programmers to build, launch, and maintain apps without worrying about the supporting infrastructure. It also

provides integrated testing as well as collaboration tools to enable rapid application development and deployment. E.g. Google App Engine, Salesforce Platform, Microsoft Azure IBM Cloud Foundry etc (Agam Srivastava, Animesh Ojha, Archana Shaji, Arti Sharma, Rashmi Pandey, et al., 2023).

Software as a Service (SaaS) uses the Internet to deliver software packages, eliminating the need to install them locally on a device. Users use a web browser to access the programs, which guarantees their usability and maintainability. Typical examples include Microsoft 365 and Salesforce, which provide all-inclusive business solutions (Pragya, Devi, et al., 2024; Syed A. S. A. Prabakar, Muniyandi, et al., 2023). Although these models have many benefits, such as cost savings and scalability, businesses must also take into account some drawbacks, particularly with regard to data security and regulatory compliance. For cloud adoption to be successful, these criteria must be balanced (Tajinder Kaur, Sushil Kamboj, et al., 2023).

Models for deploying cloud computing are important structures that determine the management and delivery of cloud services. These models balance elements such as cost, security, and control to meet various organizational needs. Public, private, community, hybrid, and the newer proprietary cloud are the main deployment models; each has unique benefits (Wright, 2024).

Public cloud

- The term "public cloud" refers to services that are shared by many users and provided via the Internet.
- Benefits include affordability, scalability, and the absence of user maintenance requirements.
- Perfect for small and medium-sized enterprises that require flexibility without a significant financial commitment (Ghosh et al., 2024; Misra et al., 2024).

Private cloud

- The term "private cloud" refers to cloud infrastructure that is used exclusively by one company.
- Benefits include increased control, security, and personalization.
- Use cases: Suitable for sectors with strict data privacy and compliance regulations (Kizzi, et al., 2023; Kaur & Kamboj, et al., 2023).

Hybrid cloud

- A hybrid cloud that enables sharing of apps and data between private and public clouds.
- Benefits include scalability and flexibility while maintaining control over private information.
- Businesses seeking to effectively manage workloads and maximize resources (Mishra et al., 2024) (Kaur and Kamboj, 2023).

Community cloud

- A shared infrastructure used by multiple organizations with similar issues.
- Benefits include cost-sharing and teamwork.
- Beneficial for businesses in related sectors such as healthcare or education (Ghosh et al., 2024) (Kaur and Kamboj, et al., 2023).

Cloud storage is like an online virtual vault where you can store your documents, movies and photos. You keep these files online instead of keeping them on a physical hard disk or PC (Nitesh Kushwaha, Akhilesh A.Woo, et al., 2023). This means that, if you have an internet connection, you can access them from any location.

The hypervisor is like a manager for the computers. Imagine a large office building where many people work. Each person has their own desk (like a virtual machine), but they all work in the same building (physical computer). The hypervisor ensures that everyone can work without interfering with each other's work.

Technologies such as VMware for virtualization and Docker for containerization were key in increasing the efficiency and utilization of computing resources during the 2010s. These tools enabled the operation of multiple virtual environments on a single physical machine, improving flexibility and overall efficiency. Furthermore, (Mahmood, Z., et al., 2011) (Pahl, C., Brogi, A., Soldani, J., & Jamshidi, P., et al., 2019) emphasized the benefits of containerization in streamlining application deployment and scaling, while (Zhang, Q., Cheng, L., & Boutaba, R., et al., 2010) highlighted its contribution to creating a more agile and responsive IT ecosystem.

Infrastructure management changed with the advent of serverless computing paradigms and cloud-native apps like AWS Lambda, which freed developers to focus only on developing code. Cloud providers handled server scaling and provisioning, relieving developers of the burden of

managing infrastructure (Hendrickson, S., Sturdevant, S., Harter, T., Venkataramani, V., Arpaci-Dusseau, A.C., & Arpaci-Dusseau, R.H., et al., 2016). A study conducted by (Adzic, G., & Chatley, R., et al., 2017). highlighted the cost-effectiveness and low operational overhead of serverless systems.

Cloud computing's ability to provide computing resources in a flexible and scalable manner over the Internet has made it a fundamental component of contemporary IT architecture. On-demand self-service, broad network access, resource pooling, instant flexibility, and scalable services are some of the fundamental characteristics of this paradigm that the National Institute of Standards and Technology (NIST) has highlighted as indicating a dramatic shift in the technological landscape (Mell, P. and Grance, T., et al., (2011).

A system that enables multiple users to access and share resources via the Internet is known as a cloud network. Imagine it as a library where multiple people can read books simultaneously. The cloud stores digital information on servers in place of physical books. This network is capable of running multiple traditional data centres. Multiple computers (servers) that store and manage data are physically housed in a traditional data centre. More processing and storage capacity can be made possible by connecting multiple of these data centres through a cloud network. Since sensitive data is often processed and stored on these shared resources, it is imperative to ensure security and privacy in cloud computing. This requires strong security measures against data breaches and unauthorized access. To protect data in the cloud while complying with various data protection regulations, it is imperative to implement encryption, access controls, and frequent security audits (Vinayak Raja, Bhuvichopra, et al., 2024).

Cloud security measures are essential to protect sensitive data, by preventing breaches and unwanted access. Using multi-factor authentication, conducting frequent security audits, and putting strong encryption into practice are important strategies. To minimize human error – which is a frequent source of incidents – organizations must focus on user education. Additionally, a thorough incident response plan is needed to promptly address breaches and minimize damage. By encouraging employees to report suspicious activity and participate in continuous training, a security-conscious culture strengthens defences against threats. A proactive security approach ensures data protection while fostering trust with stakeholders and customers in a constantly evolving threat landscape. Organisational resilience is further strengthened by efficient communication channels for incident reporting and security protocol updates (Vinayak Raja, Bhuvichopra, et al., 2024).

Related study

This study is focused on the privacy and security, of cloud computing and finds the best solution to the discussed privacy and security issues in cloud computing such as cloud services models, cloud deployment models, and basic components of the cloud. They introduced the characteristics of edge computing and analysed more security threats for encryption. The security privacy protection in cloud computing for exploring the discussion and challenges. They examined additional security risks for encryption and presented the features of cloud computing. According to the research, cloud services can improve data security by reducing latency and facilitating localized processing, which reduces the risk of sensitive data breaches (Uzoma, Benneth & Okhuoya, Bonaventure, et al., 2022). This integration is a potential way to protect sensitive data across various applications as it not only speeds up response times but also enables more powerful security measures that are suitable for certain contexts. The privacy and security concerns of cloud technologies, such as trust and encryption, are essential to guarantee the privacy and security of user data. The algorithms and techniques used to encrypt ciphertext are constantly improving, aiming to strengthen protection against unwanted access while guaranteeing effective data retrieval (Tajinder Kaur, Sushil Kamboj, et al., 2023).

Component of cloud computing

There are three fundamental components of cloud computing:

- I. Client computers:** Users can access cloud services through client computers. Such as on-promises, PCs, remote desktop environments, or your laptop, smartphones etc.
- II. Distributed servers:** The servers were distributed amongst different places but acted as if they worked with each other (Abhishek Gautam, et al., 2022).
- III. Data centres:** data centres are a collection of services (Gulia, K.,Maakar, S. K., et al, 2021).

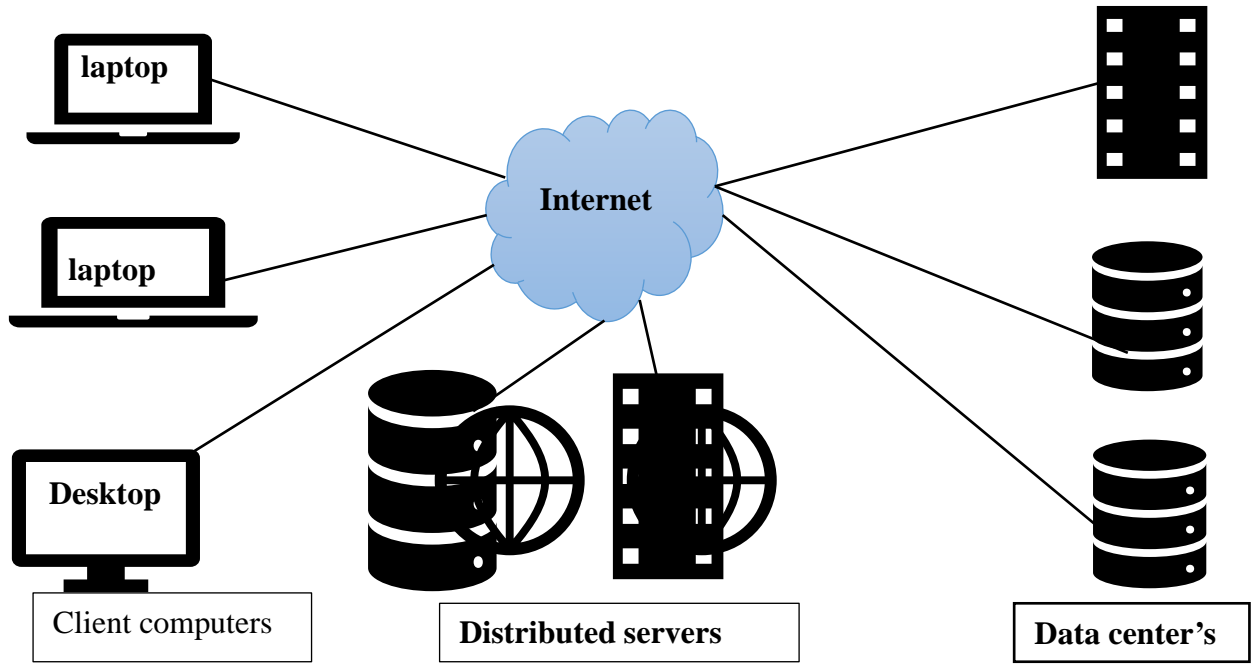


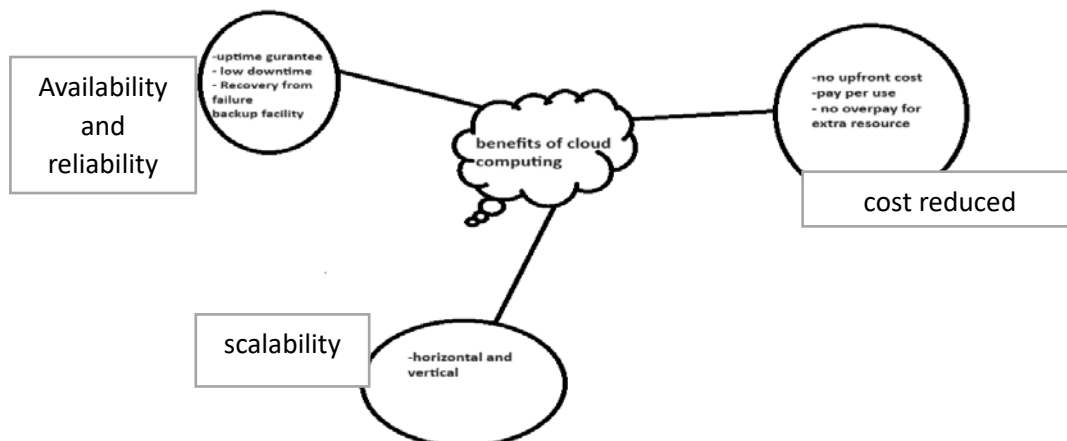
Fig 3 Components

Benefits of the importance of cloud computing

In recent years, cloud computing has become one of the primary sources for industries. The service is not only useful to businesses or companies, but it also provides a lot of opportunities to individuals wishing to store and access their data from other locations. Moreover, cloud computing can be employed for personal use with services like Microsoft One Drive, Apple iCloud, and Google Cloud. It is essential as it offers accessibility and data recovery. Cloud Computing is provided by multiple services. The main advantages include remote data accessibility, elimination of physical computer requirements for display, time and cost efficiency, enhanced security measures and the environment (SWAPNIL RAJ, 2018).

There are various benefits of cloud computing

- I. Reduced investment.
- II. Increased scalability.
- III. Increased availability and reliability.



Reduced investment:

Cloud computing does not require any upfront cost. I only have to pay for the use of the resource. There is no extra payment for additional resources which is no longer used (Karan Gulia, 2022).

Increased Scalability:

That refers to the availability to adjust resources to deliver the right amount of IT requirements. It generally comes in two varieties, vertical and horizontal, vertical scaling is focused on increasing and decreasing the capability of resources, whereas horizontal scaling adds or subtracts the number of resources (Gulia, K.,Maakar, S. K., et al, 2021).

Increased availability and reliability

When you are deploying an application or service it is important that resources are available and where they are needed at all times, regardless of possible destruction or downtime. a system can recover from failure and continue to work. You can create a decentralized design and backup facility (Ridhi R Hegde, june 2024).

Conclusion

In this review paper, I have to write a review paper on cloud computing security and privacy, a brief introduction, the privacy security of cloud computing, cloud computing service models, deployment models of the cloud and components of cloud computing as well as different approaches of cloud computing, and some benefits of cloud. Cloud computing is used in all the big and small-sized industries then we can manage cloud services like storage, hardware, etc. The future of cloud computing will be bright because of the availability of high-speed internet.

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