Sri Lanka Institute of Information Technology

B.Sc. Honors Degree in Information Technology

Specialized in Information Technology

IT4020 – Modern Topics in IT

Assignment 02

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1. Cloud computing and its evolution from traditional IT infrastructure.

Cloud computing is a paradigm that uses the internet to provide on-demand access to a shared pool of computing resources (such as servers, storage, applications, and services). The word "**cloud**" refers to the Internet, and cloud computing entails delivering IT resources and services via the Internet rather than local servers or personal computers. The primary goal of cloud computing is to provide scalable and flexible computing resources that can be provisioned and de-provisioned rapidly based on demand.

Cloud computing evolved from traditional IT infrastructure, in which companies purchased, maintained, and managed their own hardware and software. This traditional model demanded a large upfront investment, making it difficult for small and medium-sized companies to compete with bigger organizations with more resources. On the other hand, cloud computing allows organizations to access computing resources on a pay-per-use basis, making it easier to scale up or down as required.

The history of cloud computing can be traced back to the early days of the internet when organizations started to investigate the possibility of delivering software and services over the internet. In the late 1990s, the idea of "utility computing" developed, which involved the provision of computing resources as a utility, like electricity or water. This idea paved the way for the evolution of cloud computing.

Companies such as Amazon and Google started to offer cloud-based services such as Amazon Web Services (AWS) and Google Cloud Platform (GCP) in the mid-2000s. These services provided organizations with pay-per-use access to scalable and flexible computing resources. This resulted in the rapid adoption of cloud computing by businesses of all sizes, and cloud computing is now the de facto standard for providing IT resources and services.

The following are some of the **advantages** of cloud computing:

- **Scalability and flexibility**: Cloud computing enables organizations to rapidly scale up or down their computing resources based on demand, reducing costs, and increasing efficiency.
- **Cost savings**: Because cloud computing removes the need for organizations to buy and maintain their own hardware and software, significant cost savings can be realized.
- **Reliability and availability**: Cloud computing companies typically provide strong service level agreements (SLAs) that guarantee high levels of availability and reliability.
- **Security**: Cloud computing providers generally have robust security measures in place to defend against cyber threats, which can contribute to an overall improvement in security posture.

- **Innovation:** Cloud computing allows organizations to rapidly adopt new technologies and services, which can aid in driving innovation and competitive advantage.

In brief, cloud computing represents a paradigm shift in how businesses offer and consume IT resources and services. It offers a lot of advantages, including scalability, flexibility, cost savings, dependability, security, and innovation, making it an appealing option for businesses of all sizes and sectors.

2. Key components of cloud computing, including infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS)

Cloud computing is a model for delivering computing tools on-demand via the internet. Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) are the three main components of cloud computing. (SaaS).

2.1. Infrastructure as a Service (IaaS)

IaaS is the most fundamental type of cloud computing service. It enables the user to access virtualized computing tools such as servers, storage, and networking over the internet. IaaS allows the user to supply and manage these resources on-demand, paying only for what they use. Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform are examples of IaaS providers.

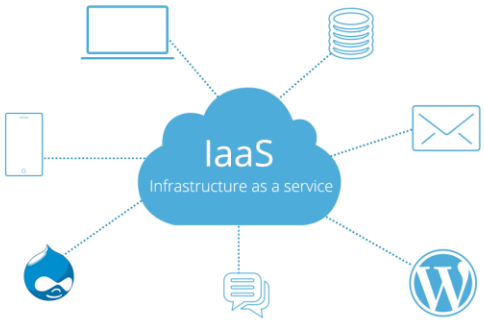

Figure 2. 1 Infrastructure as a Service

2.2. Platform as a Service (PaaS)

PaaS is a type of cloud computing that offers a platform for creating, testing, and deploying applications over the internet. PaaS provides users with a full development environment, including programming languages, libraries, and tools, without the need for them to manage the underlying infrastructure. Heroku, Google App Engine, and Microsoft Azure are examples of PaaS providers.

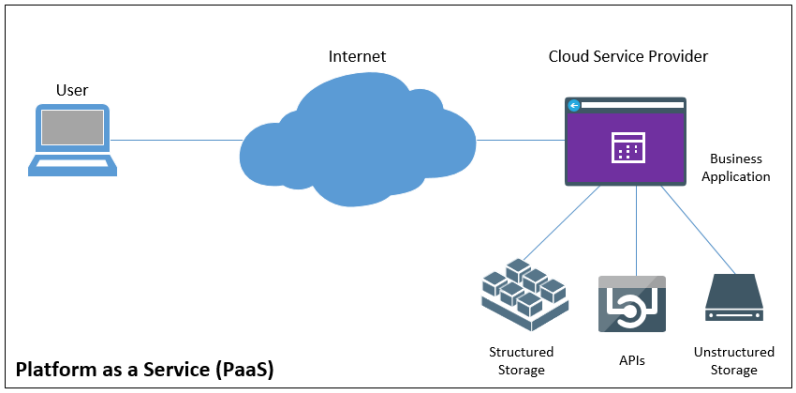

Figure 2. 2 Platform as a Service

2.3. Software as A Service (SaaS)

SaaS is a type of cloud computing that allows users to access software applications via the internet without having to install or manage the software themselves. The software is accessed via a web browser or mobile app, and the user pays a subscription charge to use it. Salesforce, Microsoft Office 365, and Dropbox are examples of SaaS providers.

Figure 2. 3 Software as a Service

3. Benefits of cloud computing, such as cost savings, scalability, flexibility, and accessibility

Cloud computing has numerous advantages over conventional on-premises computing. Among the many advantages of cloud computing are:

1. **Cost Savings**: Cloud computing eliminates the need for businesses to engage in costly hardware and infrastructure. Instead, organizations can rent computing tools on an as-needed basis from cloud service providers, paying only for what they use. This reduces capital expenditure and improves cash flow while also eliminating the ongoing expenses of hardware maintenance and upgrade.
2. **Scalability**: Cloud computing allows businesses to scale their computing resources up and down as required without having to invest in new hardware or infrastructure. This enables organizations to react quickly to changes in demand, such as increased website traffic or processing requirements, without worrying about capacity constraints.
3. **Flexibility**: Cloud computing allows organizations to choose the degree of control and customization they require. Depending on their specific requirements, they can select from various levels of cloud services such as IaaS, PaaS, and SaaS. This enables organizations to focus on their core businesses while the cloud service provider manages infrastructure and applications.
4. **Accessibility**: Cloud computing allows businesses to access their computing resources from anywhere on the globe that has an internet connection. This enables organizations to provide remote working possibilities to their workers while also ensuring the availability of their data and applications.
5. **Enhanced Security**: Cloud providers typically have extensive security measures in place to protect their infrastructure and data. By leveraging these measures, companies can improve their overall security posture and reduce the risk of data breaches. Cloud computing can actually strengthen your security posture because of the depth and broadness of security features, automated maintenance, and centralized management. [1]

In general, cloud computing allows organizations to access computing resources in a more flexible, scalable, secure, and cost-effective manner, allowing them to concentrate on their core business and react rapidly to changes in demand.

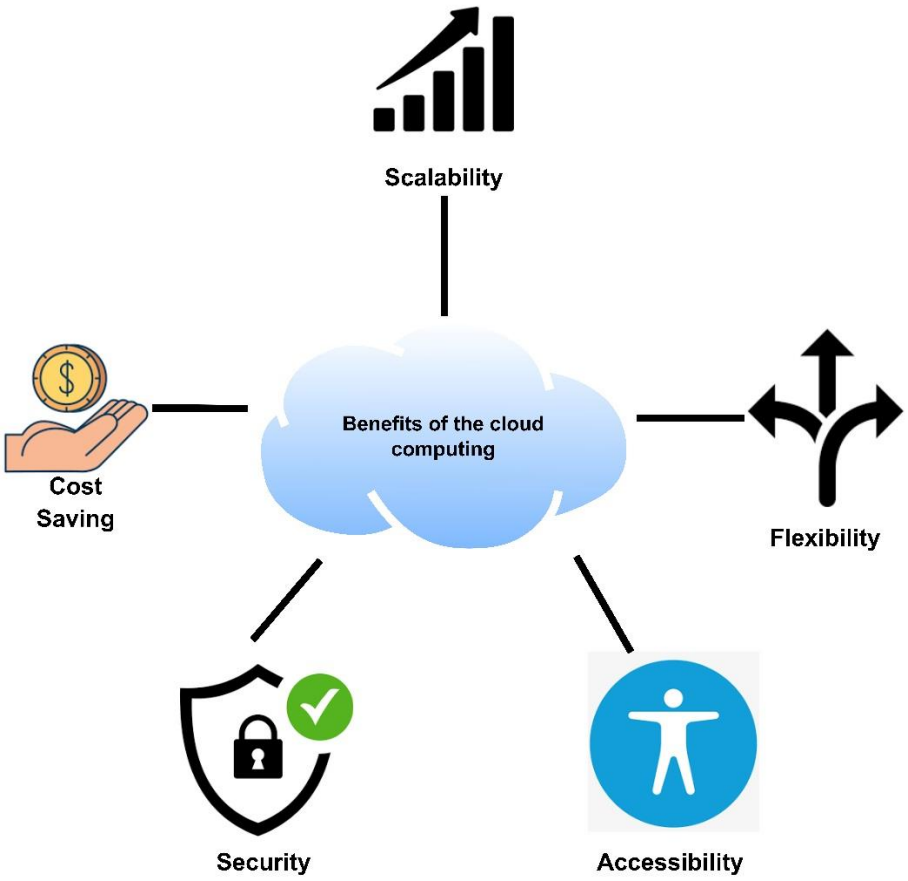

Figure 3. 1 Benefits of Cloud computing

4. Challenges associated with cloud computing, including security risks, privacy, data governance, and vendor lock-in

While cloud computing has many advantages, it also has a number of drawbacks that businesses must be mindful of. Some of the major challenges associated with cloud computing are as follows:

1. **Security Risks:** Security is one of the most difficult aspects of cloud computing. Organizations must ensure the security of their data and apps while they are in transit to and from the cloud, as well as while they are stored in the cloud. Cloud service providers generally have strong security measures in place, but organizations must also adopt their own security measures to protect themselves from threats like hacking, data breaches, and malware.
2. **Privacy:** Another issue with cloud computing is privacy, especially when it comes to storing private data. Organizations must ensure that they are in compliance with data protection laws such as GDPR (General Data Protection Regulation) and CCPA (California Consumer Privacy Act) and that they use cloud service providers with appropriate privacy safeguards.
3. **Data Governance:** Cloud computing also poses issues of data governance, such as data ownership, data management, and data sovereignty. Organizations must ensure that suitable policies and procedures, such as backup and disaster recovery procedures, data retention policies, and data classification, are in place to manage their data in the cloud.
4. **Vendor Lock-in:** Finally, when using cloud service providers, organizations must be mindful of the danger of vendor lock-in. When a company becomes reliant on a single cloud service provider, it becomes difficult to switch to another provider if necessary. Organizations can reduce this risk by implementing open standards and ensuring that their data and apps are portable across cloud service providers [1].

In conclusion, while cloud computing has many advantages, organizations must be aware of the challenges and risks it entails and take steps to mitigate these risks in order to guarantee the security, privacy, and governance of their data in the cloud.

5. Analyzing real-world examples of cloud computing adoption

Cloud computing is being used in a variety of sectors, including healthcare, finance, and education. Here are some instances of real-world cloud computing adoption in these industries:

1. **Healthcare:** The healthcare sector in Sri Lanka has embraced cloud computing to improve patient care, streamline operations, and cut costs. Lanka Hospitals, one of Sri Lanka's biggest private hospitals [2], for example, has adopted a cloud-based electronic medical records system to improve patient care efficiency and effectiveness. Furthermore, Durdans Hospital, one of the country's top private hospitals, manages patient data, appointments, and medical billing using a cloud-based hospital information system [3]. To enhance patient care and reduce administrative burden, the Ministry of Health has adopted a cloud-based electronic medical record system (EMR) [4]. The system allows healthcare providers to securely store, manage, and access patient medical data from anywhere, resulting in better patient outcomes and increased efficiency.
2. **Finance:** The Sri Lankan finance sector has also embraced cloud computing to improve operations and provide better services to customers. Hatton National Bank (HNB), one of Sri Lanka's largest banks, for example, has adopted a cloud-based core banking system to improve services and cut expenses [5]. Besides that, Cargills Bank, a major financial institution in Sri Lanka processes transactions and manages client accounts using a cloud-based core banking system [6].
3. **Education:** Cloud computing has also been adopted in the Sri Lankan education sector, especially in the field of e-learning. The Open University of Sri Lanka, for example, has adopted a cloud-based learning management system to provide students with online courses and resources. The Sri Lankan government has introduced Guru.lk, a cloud-based e-learning platform, to provide students in rural regions with access to quality education. The platform provides a variety of educational tools, such as video lectures, online courses, and interactive quizzes, which are accessible from any location.

In conclusion, cloud computing adoption in Sri Lanka is still in its early stages, but it is expected to grow as more organizations realize the benefits of cloud computing in terms of improving efficiency, lowering costs, and improving data security.

6. Comparison between different cloud services providers, such as Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP).

The three largest cloud service providers in the market today are Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP). Here is a quick rundown of their products and services:

1. **AWS (Amazon Web Services):** AWS is the market leader in cloud computing and provides a wide variety of cloud services, including computing, storage, and databases. AWS also has the most extensive global infrastructure, with availability zones in more than 20 different geographic areas. One of the primary advantages of AWS is its scalability, which enables users to scale up or down their resources as needed. AWS also has a large user community and a diverse set of third-party integrations.
2. **Microsoft Azure:** Microsoft Azure is another well-known cloud service company that provides a variety of cloud services, such as virtual machines, databases, and analytics. One of Azure's major advantages is its tight integration with Microsoft's other products, such as Office 365 and Dynamics 365. Azure also has a powerful hybrid cloud offering, enabling users to integrate their on-premises infrastructure with the cloud in a seamless manner.
3. **Google Cloud Platform:** GCP is a newer cloud service provider than AWS and Azure, but it has rapidly grown in popularity due to its innovative features and reasonable pricing. GCP provides a comprehensive set of cloud services, including processing, storage, and databases, as well as a strong emphasis on machine learning and artificial intelligence. One of the primary advantages of GCP is its ability to easily integrate with other Google services, such as Google Workspace and Google Analytics.

In terms of pricing, all three cloud service providers use a pay-as-you-go model, with prices changing depending on usage and location. AWS and Azure are generally thought to be more expensive than GCP, though pricing varies based on the services used.

In general, the choice of the cloud service provider will be determined by the organization's particular needs and requirements. Each service provides a distinct set of features and benefits, and it is critical to compare them based on criteria such as scalability, security, dependability, and cost.

AWS	Azure	Google
Developer and management tools	Big data and predictive analytics	Data management and storage
Machine learning and predictive analytics	Game and app development	App development
Databases and storage solutions	Scalable data warehousing	SMB business analytics and AI
Business productivity tools	Blockchain technology	Productivity and workload management
App integration	DevOps	
Compute	IoT integration	

Table 6. 1 AWS vs Azure vs Google

7. Emerging Trends in cloud computing

Cloud computing has rapidly evolved in the past few decades, with several emerging trends presently transforming the industry. Some of these patterns are as follows:

7.1. Hybrid Cloud Computing

A hybrid cloud environment is a mix of private and public cloud services that enables companies to reap the benefits of both environments. This trend has emerged as a solution for businesses with confidential or mission-critical data that require the security and compliance features of a private cloud as well as the scalability and flexibility of public cloud services. Furthermore, there are advantages of using a hybrid cloud include greater flexibility, enhanced security, and lower expenses. However, there are some drawbacks to hybrid cloud computing, such as the complexity of managing numerous cloud environments and possible data integration issues.

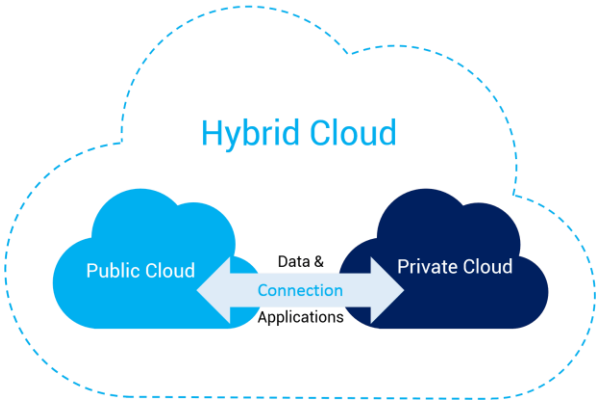

Figure 7. 1 Structure of Hybrid Cloud Computing

7.2. Edge Computing

Edge computing is the practice of processing data at or near the network's edge, where it is produced, rather than sending it to centralized cloud data centers. This method reduces latency and network congestion, which is especially essential for real-time applications such as Internet of Things (IoT) devices and autonomous vehicles, industrial automation, and smart cities. However, there are drawbacks to edge computing, such as limited computing resources, the requirement for high-speed connectivity, and possible security risks.

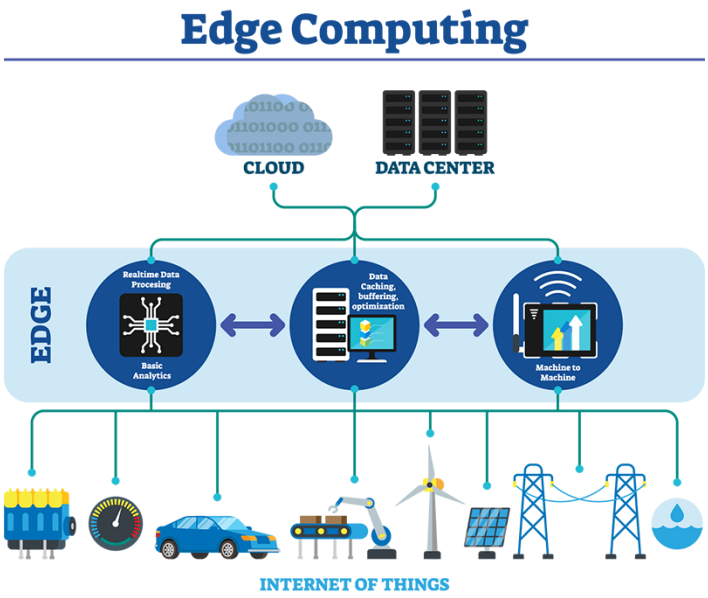

Figure 7. 2 Structure of Edge Computing

7.3. Serverless Computing

Serverless computing is a cloud computing paradigm that enables developers to create and distribute apps without being concerned about the underlying infrastructure. Serverless computing allows developers to concentrate on writing code and providing value to their customers without having to think about the operational aspects of running and maintaining servers. Serverless computing is particularly useful for applications that require frequent scaling, such as web and mobile applications, because the cloud provider handles the underlying infrastructure scaling automatically. However, there are drawbacks to serverless computing, including greater complexity in managing distributed applications and possible performance issues.

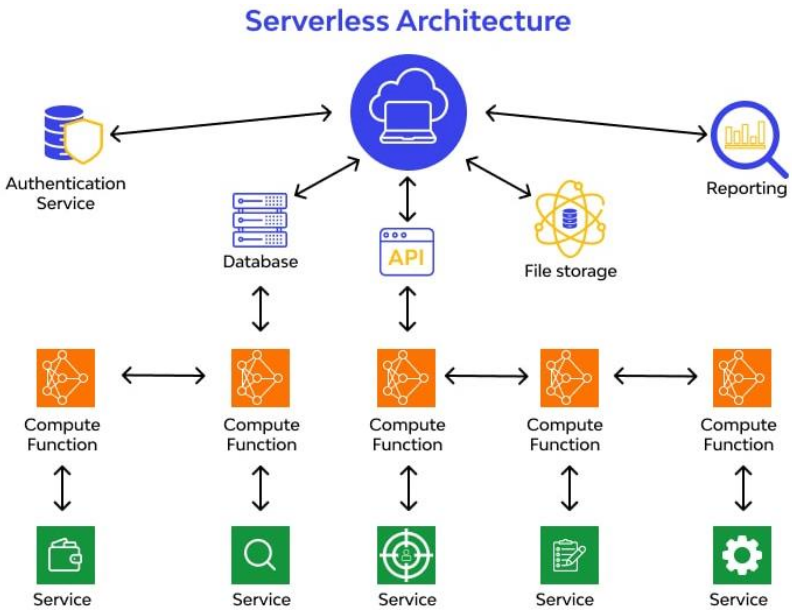

Figure 7. 3 Structure of Serverless Computing

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