OPTIMIZATION OF RESOURCE COSTS USING CLOUD TECHNOLOGIES: ANALYSIS AND CONTROL

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Annotatsiya

This article analyzes the effectiveness of using cloud technologies to optimize costs in business processes . The main advantages of cloud solutions in reducing operating costs and increasing the flexibility of the business infrastructure - are analyzed. The study also considers ways to optimize IT infrastructure costs, including reducing hardware and technical costs. Successful implementation of cloud solutions in various industries and their impact on the overall efficiency of business processes were assessed.

Kalit so'zlar: business processes, cloud technologies, operating costs, cloud solutions.

Introduction

Cloud technologies originated from the initial ideas of providing remote access to computing resources through the network. However, the concept of cloud computing, which we know today, began to take shape in the early 2000s. In the early 2000s, companies began to more effectively understand the possibilities of cloud technologies for managing and distributing computing resources. One of the most important events in the history of cloud technologies was the emergence in 2006 of Amazon Web Services (AWS) , which offered a wide range of cloud services, including data storage, computing power, and more. We can say that with the development of virtualization technologies and the spread of broadband internet, cloud technologies are becoming increasingly popular. Major technology companies like Microsoft, Google, and IBM have also introduced their own cloud platforms and services. Over time, cloud technologies have become an integral part of the modern IT infrastructure of many companies and organizations.

ensured mobility, scalability, and economic efficiency. Currently, cloud technologies continue to develop through the introduction of new capabilities such as artificial intelligence, big data analysis, and the Internet of Things, and they remain an important factor in the digital transformation of business and society. Cloud technologies- is an information technology representation model in which users access computing resources (e.g., computing power- , data storage, applications and services) via the Internet, usually via a web browser, without investing in their infrastructure. The role of cloud technologies in the digital economy is important.

RESEARCH METHODOLOGY

Problems: the benefits of using services through cloud platforms for entrepreneurs, problems that lead to a reduction in long-term time and costs. Objectives: determining the most important indicators for optimizing entrepreneurs' costs through the use of cloud technologies.

The costs of comparing services with the local infrastructure of entrepreneurs, the costs of using cloud technologies and the user's cost savings on the problem, the impact of using cloud services , costs and user recommendations. The impact of costs introduced through the use of cloud technologies and the user's savings on the problem, comparison of the business indicators of the used cloud services and the user's problem, recommendations and strategies for entrepreneurs to use cloud technologies are considered. Recommendations and Requests The use of cloud services shows what changes can be made for entrepreneurs, presentation of recommendations and technological guides for full use, methods used to obtain requests and advanced information.

LITERATURE REVIEW

"How supporting cloud technologies can reduce costs," says Andrew Ng, known for his experience in digital technologies and nuclear mechanics, "includes an analysis of what kinds of problems cloud services solve for businesses and into which parts the costs are divided." Andrew Ng promotes the study of basic cloud technologies and the development of its teaching methods. "Only through cloud solutions can one find an analysis of the impact of cloud services on areas of activity and in which areas the benefits of cloud technologies can be seen to the maximum extent." says Werner Vogels, as the supervising director of Amazon Web Services (AWS), Werner Vogels played a major role in cloud optimization, device startup, and the creation of its technologies. "It includes an analysis of how the use of cloud services will be effective for businesses in terms of average costs and service quality," says Andy Jassy, current director of Amazon Web Services (AWS) and senior cloud popularization and development expert.

RESEARCH RESULTS

Cloud technologies play an important role in the digital economy, creating a foundation for innovation, business growth, and efficiency- increasing efficiency. Some ways in which cloud technologies can impact the digital economy:

- **Adaptability and scalability:** Cloud platforms allow companies to quickly expand their computing resources- according to needs, which is especially important in a rapidly changing digital environment.

- **Economic efficiency:** Using cloud services reduces it infrastructure costs, as the company no longer needs to invest in its own servers and equipment.

- **Innovation:** Cloud platforms allow the use of advanced technologies such as artificial intelligence, data analysis, the Internet of Things, and blockchain, which contribute to the development of innovations and new business models.

- **Global access and collaboration:** Cloud solutions provide access to data and applications from anywhere in the world via the Internet, facilitating collaboration and data sharing between employees and partners.

- **Security and compatibility:** Cloud service providers typically meet high

levels of security and regulatory requirements, making cloud solutions attractive to companies operating in regulated industries.

■ **Small Business Development:** Cloud technologies provide advanced horse resources- for small and medium-sized enterprises, allowing them to compete with major market players and expand their businesses without large investments. These factors confirm that cloud technologies play an important role in the development of the digital economy, increasing efficiency, stimulating innovation, and contributing to business growth in the modern world. According to research, 4 cloud technologies remain relevant in the modern world for a number of reasons:

■ **Adaptability and scalability:** Cloud platforms allow organizations to expand their resources according to needs, making them an ideal choice for companies of any size.

■ **Economic efficiency:** Using cloud services reduces infrastructure and equipment costs- as business owners no longer need to purchase and store their own servers and equipment.
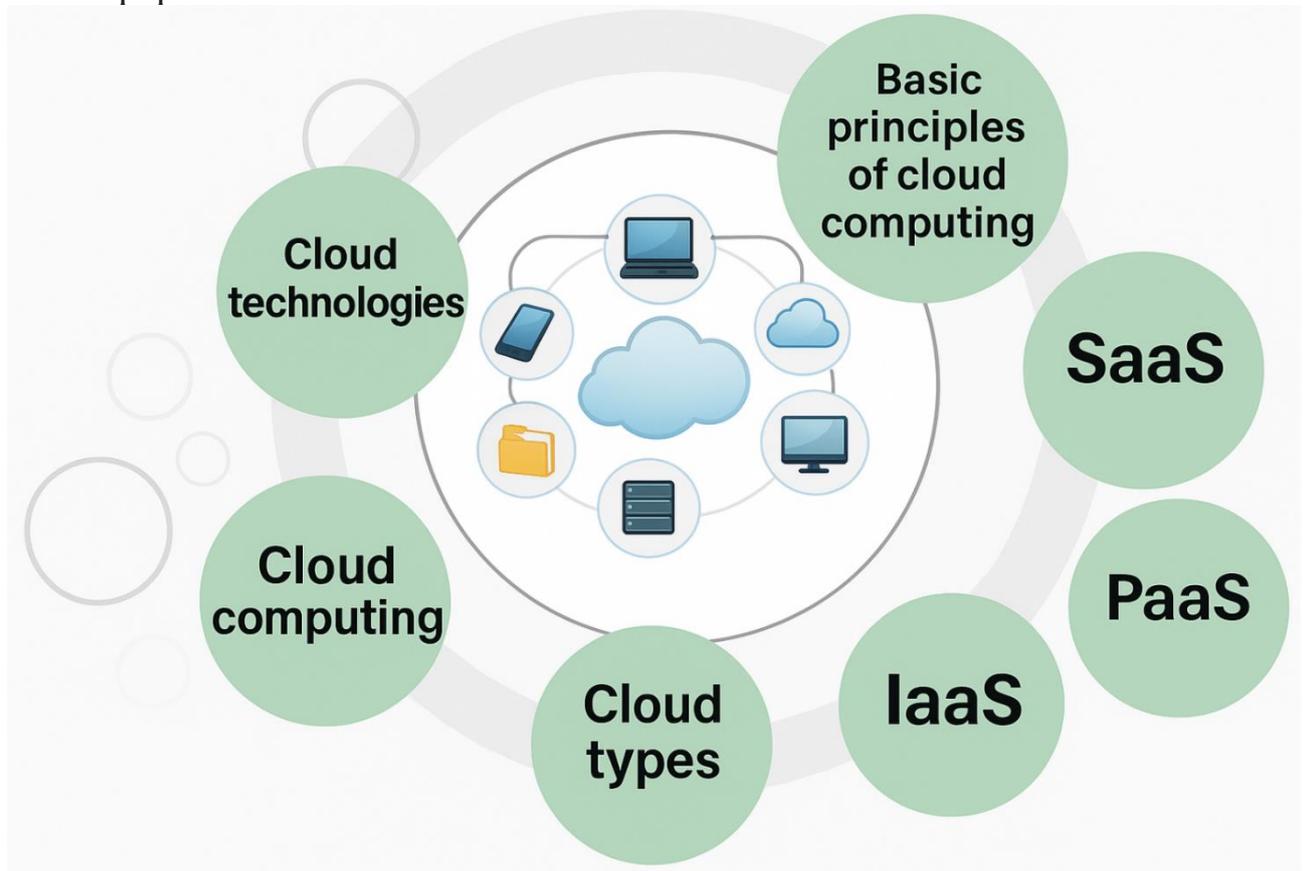

Figure 1: Using cloud technologies in the educational process

■ **Innovation and digital transformation:** Cloud platforms contribute to the development of new technologies and capabilities, such as artificial intelligence, data analysis, price- Internet of data, etc., which contributes to the competitiveness of companies.

■ **Security and reliability:** Cloud service providers typically provide a high level of security and data reliability, which makes cloud solutions attractive to companies, especially with increasing cybersecurity threats. From my point of view, the main features of cloud technologies include:- instance on demand: users can access

the necessary resources immediately, without pre-ordering or equipment installation.

■   **Scalability:** Cloud services allow you to expand computing resources depending on the needs of the business or project, allowing you to quickly adapt to changing conditions.

■   **Share:** Cloud resources can be available to multiple users from different locations at the same time, providing flexibility and ease of collaboration.

Payment for use: Payment for the use of cloud resources is often based on the "pay for use" model, which allows organizations to optimize IT costs and avoid unused resource costs. Cloud technology issues:[6]

1.   **Data security:** transferring data to the cloud may result in data leaks or unauthorized access.

2.   **Service reliability and availability:** The absence of the cloud can lead to business failure and data loss.

3.   **High price:** the use of cloud services can be expensive for small businesses.

4.   **Compatibility and integration:** Difficulties in compatibility and integration of various cloud services.

Consider their solutions in detail according to the problem description: data security.[7] Benefit- encryption Mechanisms for encrypting data at rest and in motion to protect data from unauthorized access. Implement authentication and authorization mechanisms such as multifactorial authentication-to ensure cloud access security. Conduct regular safety audits and event monitoring for the early detection and prevention of possible security incidents. Train company employees in the rules of safe use of cloud services and regularly inform them about possible threats and ways to prevent them.

Reliability and availability of services. The use of multiple regional data centers and data duplication to ensure high availability and error resistance of cloud services. Development and implementation of a data backup strategy with regular creation and verification of backups to minimize data loss in the event of an accident or failure. Continuous monitoring and optimization of cloud resource performance to prevent overload and ensure the stable operation of services.

High price. Optimizing the use of cloud resources by tracking and managing costs, such as deleting unused virtual machines or resources when inactive. Use the pricing models of cloud pro- vendors, such as the use fee or "pay for your use" model, to reduce the cost of cloud services. Consider the possibility of using cloud solutions that are as open and free as possible, and switch to cheaper cloud providers while retaining the necessary functions. Compatibility and integration. Use standardized protocols and APIs to ensure compatibility between different cloud platforms and facilitate integration between them- .

Figure 2: Share of service providers in the cloud services market

Develop and use custom solutions for integrating cloud services, such as data adapters or data integration platforms, to ensure interoperability of various cloud and local applications and services. SaaS currently accounts for one-third of the total cost of cloud services. Top 3 spending areas: SaaS - $195 billion, IaaS - $150 billion, PaaS - $136 billion. Ultimately, the conclusion is that cloud technologies play an important role in the world of modern information technologies, providing organizations and users with access to computing resources and applications via the Internet. They have a number of advantages, among which are flexibility, scalability, availability, and payment for use, which makes them an attractive choice for various tasks and needs. At the end of the study, we came to the conclusion that by using cloud technologies, organizations can significantly reduce IT costs, increase the effectiveness of their operations, can improve performance and speed up the deployment of new apps and services. Cloud technologies allow users to access their data and applications from anywhere in the world and from any device, which improves their mobility and performance. However, with all their advantages, cloud technologies also pose some difficulties and risks, such as data security, service reliability, high costs, and difficulties in compatibility and integration. However, these problems can be successfully solved with the help of appropriate strategies and technologies, such as the use of encryption and authentication mechanisms, data backup strategies, cost optimization, and compliance standards. In general, cloud technologies are a powerful tool for digital transformation of business and everyday life, providing the flexibility, scalability, and availability necessary for successful operation in a modern information society.

Cost optimization in business processes using cloud technologies can be achieved in the following ways: Reducing infrastructure costs: transferring computer resources and infrastructure to the cloud avoids the costs of purchasing and maintaining local servers and network equipment. Instead, you only pay for the use of cloud resources when needed, which can significantly reduce initial investments and operating costs.

Scalability and flexibility: Cloud platforms allow you to quickly expand resources according to the needs of your business. This means that you can increase or decrease the power of the cloud, data storage, and other resources depending on the current requirements, which allows you to manage costs effectively.

Figure 3: Cloud Services Market

The cloud computing market consists of three main segments: software as a service (SaaS), infrastructure as a service (IaaS), and platform as a service (PaaS). Together, these segments allow users- to access software, store data, and develop new applications 100% remotely.

As of 2023, the cloud application market is estimated at approximately $153.6 billion. The market grew year by year, exceeding $30.4 billion in 2013 and $100 billion in 2018. The cloud application market is expected to reach $168.6 billion by 2025. According to the latest forecasts of the Gartner agency, the total costs of end users for cloud services in 2023 will amount to 591.8 billion dollars. This is 20.7% more than $490.3 billion in 2022, which is 18.8% more than projected at the beginning of this year.

Improving work efficiency: cloud technologies offer various tools and programs for automating and optimizing business processes- . For example, you can use cloud CRM systems for customer relationship management, cloud project management systems for task coordination and employee performance, or cloud platforms for data analysis and decision-making. This allows reducing human labor costs, reducing task completion time, and increasing efficiency. Security enhancement: Many cloud providers offer a high level of security and data protection. They invest in advanced encryption technologies, multi-level authentication, and security monitoring, which allows businesses to implement their own security measures andn reduces the risk of data corruption. Eliminating the need for service and updates: cloud providers take responsibility for maintaining and updating infrastructure and software. This will free you from the costs of training, supporting, and updating your dog groups, while allowing you to focus on core activities and save money. The overall impact of using cloud technologies to optimize costs in business processes is to increase efficiency, flexibility, and scalability, reduce infrastructure investments, improve security, and reduce operating costs.

Cloud computing Applies to any service provided via the Internet. The essence of cloud technologies is to provide users with remote access to services, computing resources, and programs (including operating systems and infrastructure) via the Internet. The development of this hosting industry (hosting services that allow the client's equipment to be located in the provider's territory, providing its connection to communication channels with high bandwidth) was associated with the emergence of a need for software and digital services, but it could be more economical and efficient. These Internet services, also known as "cloud services," can be divided into three main categories: infrastructure as a service, platform as a service, software as a service, compared to the traditional approach, cloud services mean that you can manage large infrastructures, serve different user groups in the same cloud, and be completely dependent on the cloud provider.
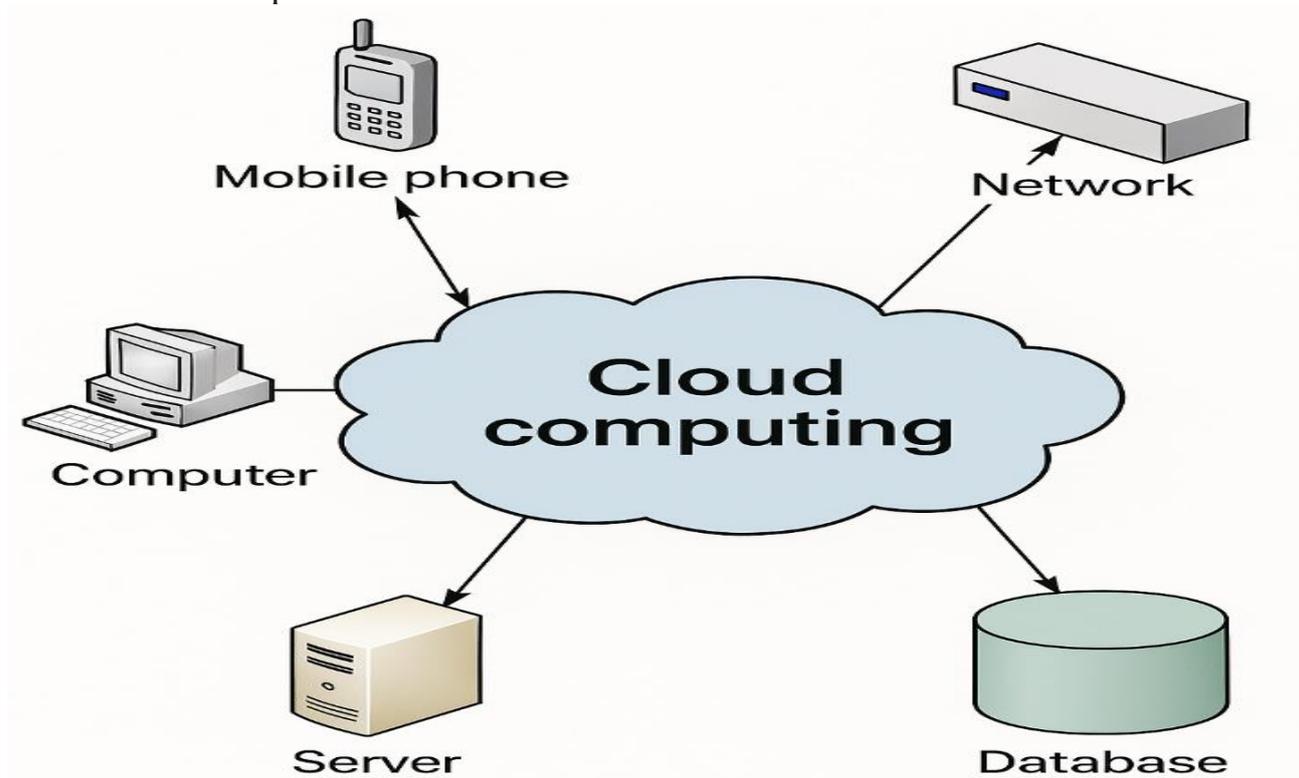

Figure 4: Cloud computing paths

In providing the cloud service, the "use fee" type of payment is applied. Typically, the unit of measurement for working time is the minutes or hours of resource utilization. When assessing the volume of data, a megabyte of stored data is taken as a unit of measurement. In this case, the user pays the full amount of resources consumed during a certain period of time. In addition, cloud infrastructure allows the user to "increase" or "decrease" the maximum limits of allocated resources as needed, thereby benefiting from the flexibility of the provided service. The user of cloud services should not worry about the infrastructure that ensures the functioning of the services provided to them. The service provider assumes all tasks related to installation, troubleshooting, infrastructure expansion, etc. Cloud types can be public or private. A private cloud is an infrastructure intended for use by a single organization, which includes several consumers (for example, subdivisions of one organization). A private cloud can be owned, operated, and managed by the organization itself or by a third

party (or their association) and can physically exist both within the owner's jurisdiction and outside of it. The public cloud is an infrastructure intended for free use by the general public. Public cloud commercial, scientific, and may be owned, operated, and managed by governmental entities (or any combination thereof). The public cloud is physically owned by the service provider. A hybrid cloud is a combination of two or more different cloud infrastructures (private, public) that remain unique objects, but are standardized for data and applications or interact with private technologies (for example, short-term use of shared cloud resources to balance the load between clouds). The public cloud is a type of infrastructure intended for use by both the community of certain users, which consists of organizations with a common purpose. Public clouds can be jointly owned, operated and managed by one or more government agencies or third parties (or any combination thereof), and physically exist both within the jurisdiction of the owners and outside of it. In practice, the boundaries between all these types of calculations are blurred. Three layers of cloud services are infrastructure as a rental service (IaaS). The User- is provided with a unique IP address or a set of addresses and a "clean" copy of the virtual server with a certain amount of memory. The provider provides the user with a programming interface (API) to manage parameters, start and stop copying.Platform as a service (PaaS) PaaS is a ready-made infrastructure consisting of one or more virtual servers. PaaS can be presented as a ready-made virtual platform consisting of one or more virtual servers running an operating system or special software. Many cloud providers offer users a choice of various cloud environments that can be used outside the box. SaaS (software as a service) The SaaS concept allows users to use software as a service and work remotely over the Internet. SaaS allows working remotely via the Internet. This approach allows you not to buy software products, but to use them temporarily when necessary. The advantage of cloud computing is that users pay for services only when needed and, more importantly, only for what they use. Cloud technologies eliminate the need to purchase, store, and update software and hardware. Scalability, error resistance, and security - depending on the application's needs, the necessary resources are allocated and freed up automatically. The service provider handles the maintenance and updating of the software. Remote access to cloud data is working from anywhere in the world with internet access. The downside of cloud computing is that users do not have internal cloud infrastructure and do not have access to it. Profit- The security of the user's data largely depends on the provider's company. Current disadvantages for Russian users: reliable and fast internet access is required to receive high-quality services. Online service providers are at risk of losing data one day because they don't create backups of their data, and their servers stop working. By storing data in online services, users lose control over their data and restrict their freedoms (users cannot modify part of their data and it is stored in uncontrolled conditions). Examples of using cloud technologies in education include electronic diaries and journals, tables and teachers' personal accounts, and interactive reception rooms. These are thematic forums where students can exchange information. These are also information seekers that allow students to solve specific educational problems in the absence of a teacher or under their guidance. For this purpose, the following can be used: computer programs, electronic textbook simulators, diagnostic, testing, and training systems,

practical and instrumental software, laboratory complexes, multimedia-based systems, telecommunication systems (e-mail, telephone, cloud technologies, Microsoft cloud for education, Microsoft: Office 365, Azure Education, Microsoft Office 365), which allow educational institutions to take advantage of all the advantages of cloud services. Basic features such as Exchange Online, SharePoint Online, cloud versions of Office Web Apps, and Lync Online with videoconferencing are available for free. Thus, teachers have the opportunity to incorporate one of the newest and fastest-growing technologies into their theoretical and practical experience. It is no secret that in the coming years, the demand for cloud computing specialists in the labor market will increase significantly, and Windows Azure in the education system will allow universities to train such specialists. Cloud computing involves executing programs and storing data on servers located in distributed data centers accessible via the Internet. To develop and launch such programs, you need a special cloud platform. Such a platform is Windows Azure, a cloud partner of Windows Server. However, if Windows Server is software that can be purchased and installed on servers in local data centers, then the Windows Azure platform is located in Microsoft data centers and allows for the remote development and launch of programs. Software12 does not need to be purchased and installed; you simply pay for computing and power rental on the Microsoft data center platform. How Windows Azure Works Windows Azure is a program. Virtual based on personal examples based on machine control. Developers decide how much memory is needed and what processing capacity (number of virtual machines) is required, and the platform provides the corresponding resources. If new client requirements change the initial resource requirements, the platform allocates additional resources for the application or reduces unused data center resources The PaaS (service-oriented platform- form) model is characterized by the separation of application and infrastructure. The developer simply determines the amount of resources required for the application, and all actions to provide the requested resources, manage them, dynamically deploy, monitor, and scale are carried out automatically. For students wishing to independently study cloud technologies or work on cloud computing projects, Microsoft also offers free access to Windows Azure, which can be added to the educational process without restrictions.

Teacher: 5-month implementation period 2 small computing nodes 3 GB storage 2 connection to service bus 2 SQL Asure Web Edition (1 GB) students: work completed. Access to cloud technologies SaaS business processes- in practice - cloud technologies. General viewpoint The essence of the cloud technology concept is to provide end users with remote dynamic access to services, computing resources, and applications (including operating systems and infrastructure) via the Internet. The development of the hosting industry has created a demand for software and digital services, which can be managed at home, but are more efficient in terms of cost reduction and scale expansion. Most service providers offer cloud computing in the form of VPS hosting, shared hosting, and SaaS (software as a service) - Cloud services such as Microsoft-based Exchange and SharePoint have been provided as SaaS for some time. It must be acknowledged that cloud computing technology has enormous potential. This is due to the fact that all modern computer products have increasingly high requirements for the technical equipment of computers, which inevitably leads to

the cost of their updating. In the gaming industry, the requirements for system resources are especially high. Therefore, the technology can solve the problem of excessive resource requirements for end-users.
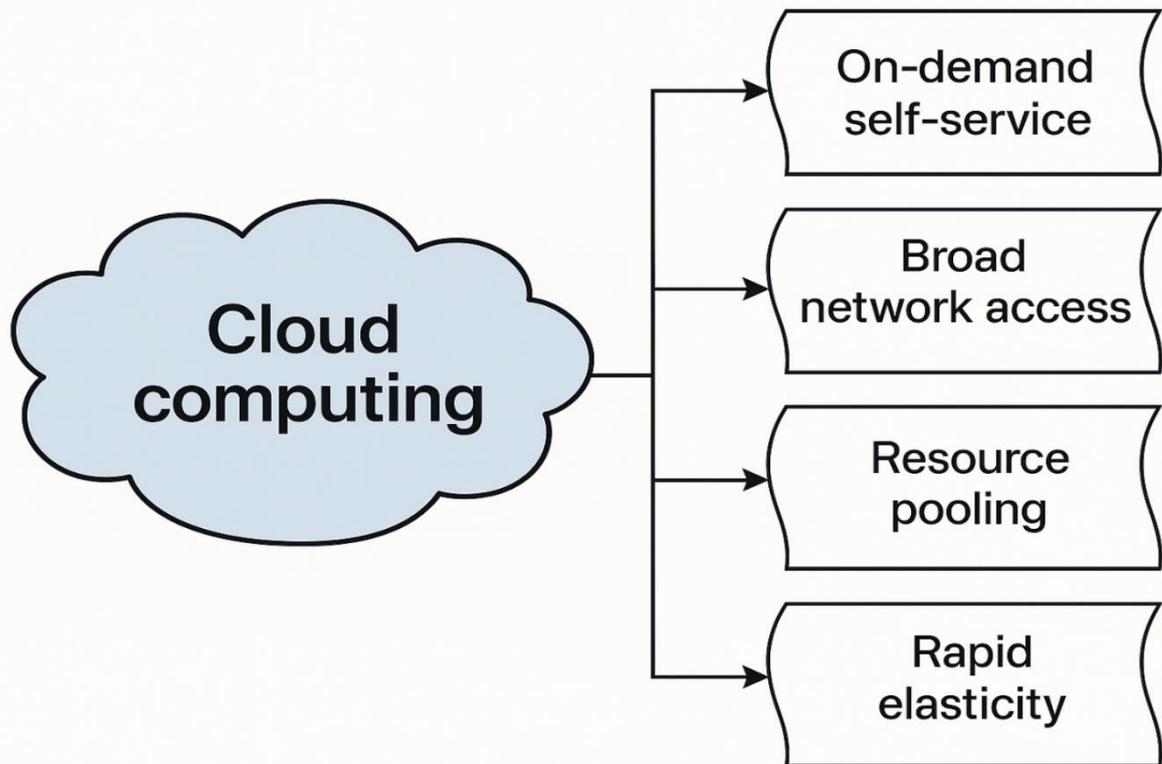

Figure 5: Main Cloud Computing Models

1. In business processes, cloud technologies consist of thousands of servers located in computer cloud data centers and manage tens of thousands of applications that are simultaneously used by millions of users.

To effectively manage such a large infrastructure, it is necessary to make it as automated as possible. In addition, to ensure secure access to computing resources for various types of users - cloud operators, service providers, vendors, IT administrators, and application users, the cloud infrastructure must ensure self-management and delegation of authority. He must be capable of self-government and delegation. The concept of cloud computing has significantly changed the traditional approach to application delivery, management, and integration. Compared to traditional approaches, cloud computing involves managing large infrastructures, serving different user groups in the same cloud, and full dependence on the cloud provider. However, such dependency is only theoretical, since providers have at least a path to data theft precedent will cause serious damage to the entire long-distance delivery industry. Cloud computing is a powerful tool for independent software developers (ISV), telecommunications companies, and software (SaaS type), allowing for increased revenue and expansion of sales channels. This approach- allows users to offer services dynamically, pay for publications, and adapt resources to their real needs without long-term obligations. Cloud computing provides huge growth opportunities for hosts. The cloud computing industry is developing rapidly: analysts predict that by 2012, IT costs will constitute 9% of all costs. In addition, - old, the industry is accelerating the transition from cloud computing and hosting to SaaS, and clients

expect to move in this direction. The main advantage of using the cloud is that the end user does not have to have a powerful system, which, of course, leads to significant cost savings; the second advantage is that all incoming traffic is managed by an authorized provider, therefore pirated content cannot be used. That's it.

Thus, one of the most global problems in the computer industry today - piracy - can be solved. According to Parallels, in the next five to ten years, most dogs will switch to five types of clouds: Google (Category 1), Microsoft (Category 2) and other large IT companies (Category 3) will have private platform clouds that serve various platforms, such as IBM, Apple, HP, and Amazon.

Service clouds (Category 4) with thousands of cloud providers offering a wide range of services will also appear. For example, web application deployment, vertically integrated organizations (e.g., government, medicine), Internet providers (e.g., strategic business development, customer support systems), and telecommunication services (voice mail, VoIP). Finally, there is the IT Management Enterprise Cloud (Category 5), which provides services for internal use, as well as for use by employees and partners.

Platform clouds 2nd category: Microsoft cloud, 3rd category: other clouds (for example, IBM, Apple-Amazon, Face- book, Adobe) service clouds, 4th category: service provider clouds - carriers, web hosts, Internet providers, SaaS, 5th category 5th category: today's internal clouds of large enterprises (Fortune 1000) The key to success in the competitive IT market is outsourcing in the 5th or 4th category cloud. To solve the problem, Parallels will partner with solutions, ecosystems, service providers, and businesses to create an effective cloud computing infrastructure. In addition, Parallels continues to develop the SaaS business to provide providers and service providers with the opportunity to offer SaaS software - notation that meets the most modern industry standards.

2. Software as a Service (SAS) technology is an example of using business software as an Internet service- . The application operates on the servers of the SaaS provider, and the user can access it through an Internet browser. Users do not buy the SaaS program, but rent it. Thus, one of the main advantages of Saas is economic benefit.

The Provider takes care of the software's functionality, provides technical support to the use , and independently installs updates. Thus, the user can think less about technical aspects and focus on business goals. The main advantages of SaaS over traditional software:

- Affordability of ownership. - The implementation period is shorter.
- Easy access (free trials available).
- All maintenance and system updates fall on the shoulders of the SaaS provider.
- The full mobility of users is limited only by the "Internet access range."
- Support for geographically distributed companies and remote staff.
- Low power consumption of the user computer.

Platform for interaction. The disadvantages of SaaS are the security of transferring commercial data to third-party providers, uncertainty of access due to low speeds and Internet interruptions, and alternative SaaS technologies are emerging.

They are intermediate variants of the transition from traditional software to Saas, which may soon disappear.

S+S is an alternative brand promoted by Microsoft, which differs from SaaS in that it uses a software client on the user's computer, not a browser- .

3. The use of cloud technologies was announced in 2011 with the commercial system Windows Azure. Like traditional operating systems, Windows Azure allows running programs and storing data, but this is done not on the user's computer, but on the computing cloud. The Windows Azure operating system is part of the Windows Azure platform and is a group of cloud software development technologies that include elements:

■ Windows Azure, which stores the Windows environment and data in Microsoft data centers to run these programs;

■ SQL Azure provides a SQL server-based relational database - SQL Azure provides a SQL server-based relational database.

Data can be stored both in the cloud and on the enterprise wall, but when interacting with Windows Azure applications, the Windows Azure Platform AppFabric integrates applications that run both in the cloud and in the traditional environment, ensuring secure data transmission. Despite the similarity in name, Fabric and AppFabric are not the same. The first is the interaction of physical machines within the cloud OS, the second is the interaction of programs operating in different environments. Windows Azure OS itself also includes a computing service, a storage service, and a Fabric service. The service that provides interconnection between applications running in the cloud environment is Mato. The main goal of the cloud platform- is to support programs running by several users simultaneously.

CONCLUSIONS AND PROPOSALS

Windows Azure stores multiple copies of the same code on different physical servers. Apps can run in multiple versions on multiple virtual machines, each of which is powered by a Hyper-V-based hypervisor modified for the cloud.

Cloud applications have two different operating versions: web roles and work roles, the first of which can perform HTTP or HTTPS requests, and the Internet Information Services (IIS) server ASP programme- operates on the mer's own virtual machine (VM).

We recommend using the Windows Communication Foundation (WCF) or another internet technology that works with IIS to create a version of the NET or web role.

Applications can be created in any programming language. Conversely, work roles can be used to receive requests from background tasks not intended for performing IIS tasks, such as web roles.

Cloud technologies play an important role in automating processes for enterprises and organizations, increasing integration, and providing conveniences for data and services.

These conveniences allow businesses to optimize their costs, as well as increase them, increase efficiency, and introduce innovations. Cloud services are also studying their position in providing services for small and medium-sized enterprises. This will allow them to provide wide opportunities and increase the number of small business

systems and services, as well as provide them with wide amenities and increase the speed of construction and commissioning for a short period of time.

References:

1.   Rajkumar Buyya, James Broberg, Andrzej Goscinski. Cloud Computing: Principles and Paradigms. - 2011.

2.   Joe Weinman. Cloudonomics: The Business Value of Cloud Computing. - 2012.

3.   Michael J. Kavis. Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS). - 2014.

4.   Thomas Earl. Cloud Computing: Concepts, Technology & Architecture. - 2013.

5.   Cornelia Davis. Cloud Native Patterns: Designing Change-Tolerant Software. - 2019.

6.   https://infocom.uz/cloudly-services-statistics.

7.   https://kompy.info.

8.   https://cyberleninka.ru.

9.   https://cyberleninka.ru/article/n/ advantages-and-disadvantages of cloud technologies

10.   http://www.myshared.ru/slide/1446214.

11.   https://ebook.tsue.uz/public/ebooks/cloud technolog