The history of cloud computing

The concept of distributed computing was first voiced back in 1960. by John McCarthy, who suggested. that after some time all calculations will be carried out using common resources. But then it remained only an opinion, which no one could, and did not try to implement.

For the first time, the idea of what we now call cloud computing was voiced by JCR Licklider in 1970. During these years, he was responsible for the creation of ARPANET (Advanced Research Projects AgencyNetwork). His idea was that every person in the world will be connected to a network from which he will receive not only data, but also programs.

The development of cloud technologies was suspended until the 90s, after which a number of factors contributed to further development:

1. The expansion of the bandwidth of the Internet in the 90s did not allow to get a significant leap in the development of cloud technology, since practically no company and technologies of that time were ready for it. However, the very fact of the acceleration of the Internet gave impetus to the rapid development of cloud computing.

2. The emergence of Salesforce.com in 1999. This company became the first company that provided access to its application through the site, on the principle of "software as a service" (SaaS).

3. Development of a cloud web service by Amazon in 2002. Danin's service allowed storing information and making calculations.

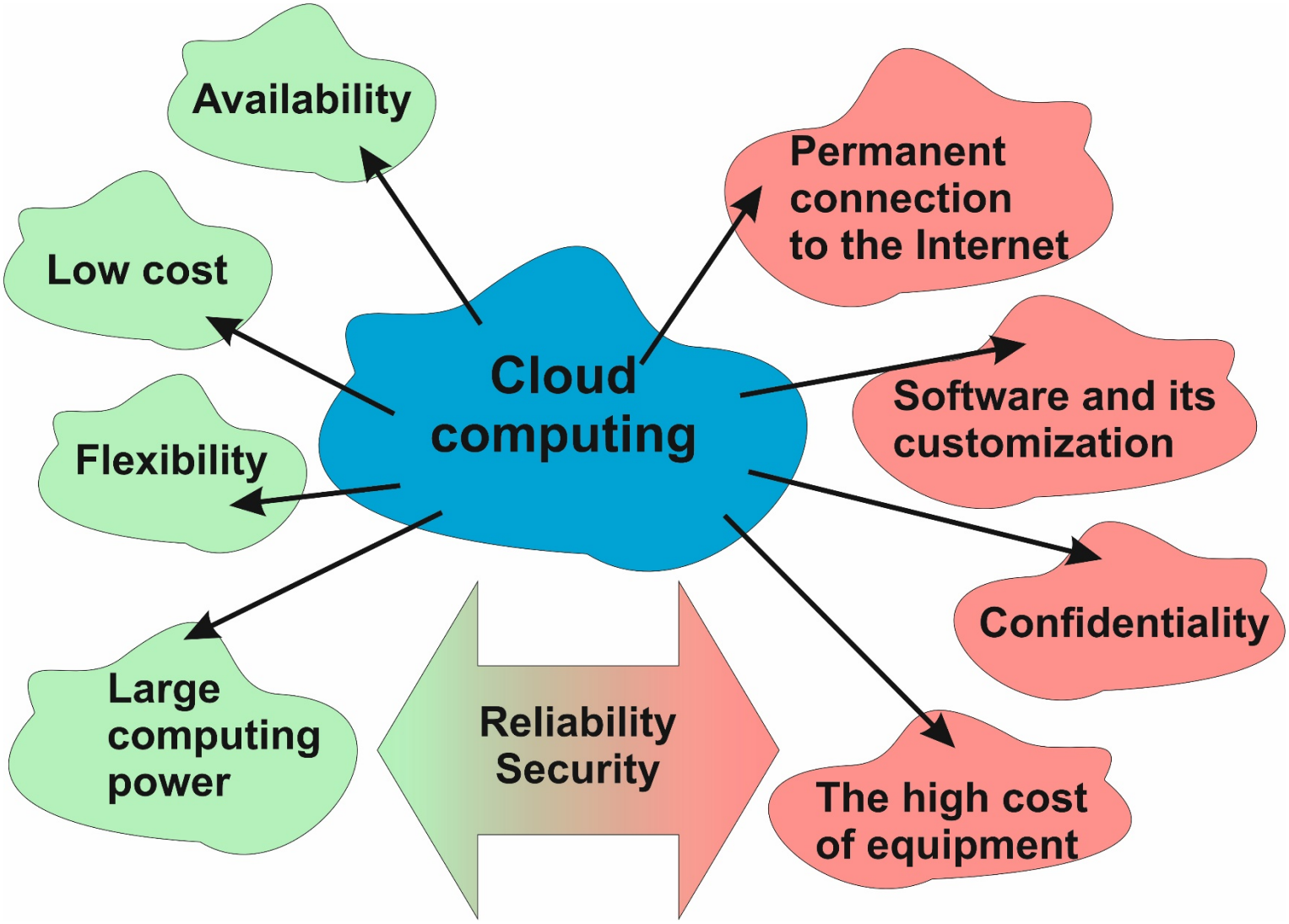
4. In 2006, Amazon launched a service called Elastic Computecloud (EC2) as a web service that allowed its users to run their own applications. Amazon ES2 and Amazon S3 services became the first available cloud computing services.

5. Creation by Google of the Google Apps platform for web applications in the business sector.

6. Virtualization technologies - software that allows you to create a virtual infrastructure.

7. Creating multi-core processors and increasing the capacity of information storage devices.

8. The real development of cloud computing began only in 2007, when the requirements for the speed of calculations began to overtake the capabilities of the computers on which the calculations were to be carried out. Since then, the development of "clouds" has been rapid, many companies switched to them at the first opportunity, and soon services that provide distributed computing services to their customers appeared.


Availability
Permanent connection to the Internet
Low cost
Cloud computing
Software and its customization
Flexibility
Confidentiality
Large computing power
Reliability
Security
The high cost of equipment

Cloud computing is a model of providing ubiquitous and convenient on-demand network access to common computing resources (data storage devices, applications, servers, applications, etc.) that can be quickly provisioned and released with minimal operational costs and/or requests to the provider.

Most of the modern providers of solutions in the field of cloud computing provide the opportunity not only to use existing cloud platforms, but also to create their own, which meet the technological and legal requirements of customers.

Advantages of virtualization technologies include:

1. Effective use of computing resources. Instead of having multiple servers at 5-20% load, you can use one that is 50-70% used.

2. Reduction of infrastructure costs: virtualization allows to reduce the number of servers and related IT equipment in the information center. As a result, the needs for maintenance, power supply and cooling of hardware resources are reduced and significantly less money is spent on IT.

3. Reduction of software costs.

4. Increasing flexibility and responsiveness of the system: virtualization offers a new method of infrastructure management and helps IT administrators spend less time on repetitive tasks - for example, on initiation, configuration, monitoring and maintenance.

5. Incompatible applications can run on the same computer.

6. Increasing the availability of applications and ensuring the continuity of the organization's work. "Fall" of one virtual server does not lead to the loss of other virtual servers. In addition, in the event of failure of one physical server, it is possible to automatically replace it with a backup server. And this happens imperceptibly for users. This ensures the continuity of the organization's activities.

7. Possibilities of easy archiving.

8. Improvement of infrastructure manageability. Many institutions do not fully utilize the available data storage capacity and use less than 30% of the capacity of their servers. A low level of utilization in this case indicates the availability of idle reserve capacity necessary to meet periodic or unexpected demand for the performance of key functions

Cloud services.

Cloud computing is a new paradigm that assumes distributed and remote data processing and storage. The cloud is nothing more than a large data center (or a network of interconnected servers).

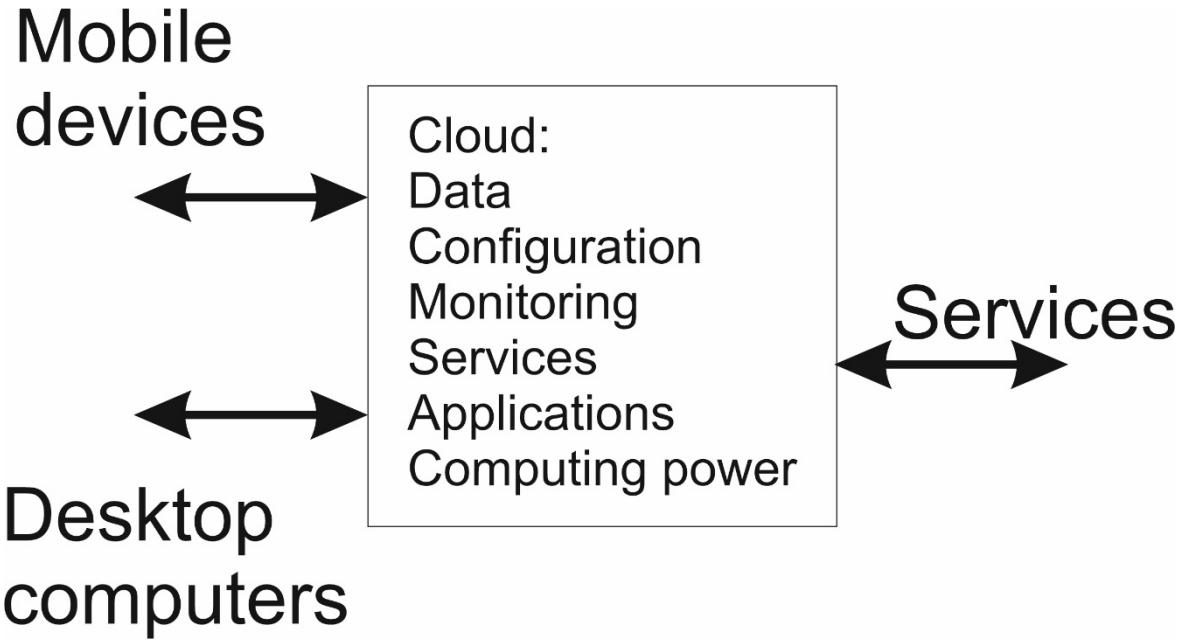
The developers of cloud technologies themselves define them as an innovative technology that provides dynamically scalable computing resources and applications over the Internet as a service managed by a service provider.

The concept of cloud computing has significantly changed the traditional approach to application delivery, management and integration. Compared to the traditional approach, cloud computing allows you to manage larger infrastructures, serve different groups of users within the same cloud, and also means full dependence on the cloud service provider.

To ensure the coordinated operation of computers that provide cloud computing services, specialized software is used, generally called "middleware control". This software provides monitoring of equipment status, load balancing, provision of resources to solve the task.

In general, cloud computing services are online applications that are accessed through a regular Internet browser.

Cloud computing is a model for providing ubiquitous convenient network access to configurable computing resources that can be put into use quickly and with minimal costs for management or interaction with the provider.



Cloud architecture hides the details of resource allocation from the user.

Advantages of cloud computing:

• Reliable equipment. Cloud providers have resources for data transmission, storage and processing: storage, servers, networks, software and much more.

• Security. The operator of cloud services is responsible for saving data. For example, it organizes encryption, protection against attacks and recovery after failure.

• Development of technology. There are many companies engaged in cloud technologies on the global market. The list of services is diverse: per-second pricing, private, public and hybrid clouds, round-the-clock technical support, several data centers in different locations.

Disadvantages of cloud computing:

• Delay in data transmission between the client and the data center. Data is transmitted from the client to the data center and back, passing many kilometers of networks. This can create delays.

• Complex and expensive infrastructure. If the company does not want to use a public cloud, it chooses a private or hybrid cloud. But setting up and maintaining a large data center in production is a costly task.

There are a number of service models.

1. Software as a service (SaaS) - a model in which the consumer is given the opportunity to use the provider's application software. which works in the cloud infrastructure and is accessible from various client devices or with the help of a client, for example, from a browser (for example. webmail) or an application interface. Control and management of the main physical and virtual infrastructure of the cloud, including networks, servers, operating systems, storage, or even individual capabilities of the application (with the exception of a limited set of program configuration settings intended for the user) is carried out by the cloud provider.

Application services (Software as a Service - SaaS) assume access to applications as a service, that is, the provider's applications are launched in the cloud and provided to users on demand as services. In other words, the user can access software deployed on remote servers using the Internet, and all issues of updating and licenses for these programs are regulated by the provider of this service. Payment in this case is made for the actual use of the software. Sometimes providers make these services free, as they have the opportunity to receive income, for example, from advertising.

The application is accessible via various client devices or through thin client interfaces such as a web browser. or webmail. or program interfaces. At the same time, the consumer does not manage the basic infrastructure of the cloud, including networks, servers, and operating systems. You are solely responsible for saving access parameters (logins, passwords, etc.) and following the provider's recommendations for secure application settings.

Application services are most familiar to the everyday user. The most common example of applications of this type are mail services Gmail and others. In general, there are thousands of SaaS applications, and thanks to Web 2.0 technology, the number is growing every day. Among the application services, there are many applications aimed at the enterprise community. There is software that manages payroll, human resources, collective work, relationships with clients and business partners, etc.

Advantages: Reduction of capital investments in hardware and labor resources; reducing the risk of investment loss; smooth iterative update.

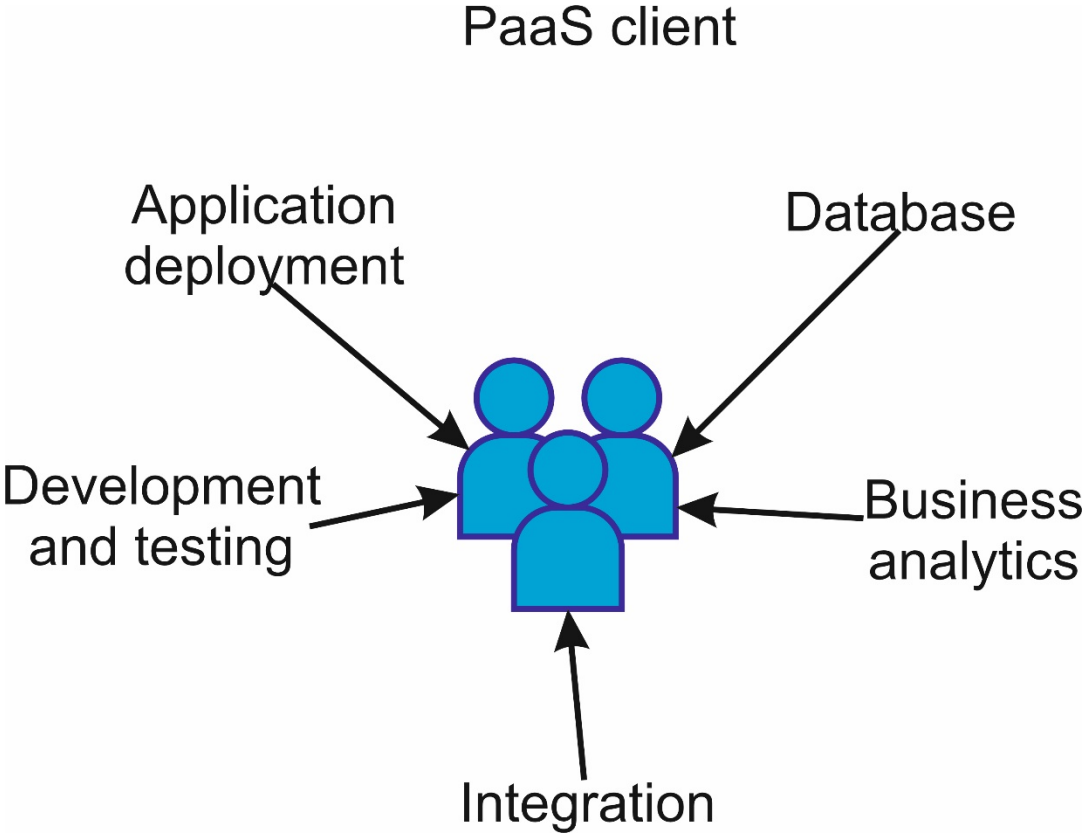
Disadvantages: As with the previous two models, centralization requires robust security measures.

2. Platform as a service (PaaS) - a model when the consumer is given the opportunity to use the cloud infrastructure to host basic software for the subsequent placement on it of new or existing applications (own, developed to order or purchased replicated applications). Such platforms include tools for creating, testing and executing application software - database management systems, connecting software, programming language execution environments - provided by a cloud provider. Control and management of the main physical and virtual infrastructure of the cloud, including the network, servers, operating systems, storage is carried out by the cloud provider, with the exception of developed or installed applications, as well as, if possible, the configuration parameters of the environment (platform).

An example is the cloud service of Microsoft - Windows Azure. Windows Azure creates a single environment that includes cloud analogues of Microsoft server products (SQL Azure relational database, which is an analogue of SQL Server, development tools (.NET Framework and Visual Studio, equipped with the Windows Azure Tools set in version 2010).

Platform as a Service (PaaS) is a service model in which applications (created or purchased) are provided to the consumer as a set of services. It includes, in particular, middleware as a service, messaging as a service, integration as a service, information as a service, communication as a service, etc. For example, Workplace as a Sendee - WaaS allows a company to use cloud computing to organize its employees' workplaces by configuring and installing all the software necessary for the staff's work. Data as a service (Data as a Sendee - DaaS) provides the user with disk space that he can use to store large amounts of information. Security as a Service (Security as a Sendee - SaaS) enables users to quickly deploy products that allow for secure use of web technologies, email security, and local system security. This service allows users to save on the deployment and maintenance of their own security system. In other words, the PaaS model is laaS together with the operating system and its application programming interface (API - Application Programming Interface). The consumer does not manage the basic infrastructure of the cloud, including networks, servers, operating systems and storage systems, but has control over the deployed applications and possibly some configuration parameters of the hosting environment. Thus, the consumer must take care to ensure the security of the applications that will be deployed on the provided platforms.

Applications can work both in the cloud and in traditional enterprise data centers. To achieve the scalability required in the cloud, the various services offered are often virtualized, just like the infrastructure services discussed earlier.



3. Infrastructure as a service (laaS) is provided as an opportunity to use cloud infrastructure to independently manage processing, storage, network and other fundamental computing resources, for example, the consumer can install and run arbitrary software, which may include operating systems, platform and application software. The consumer can control operating systems, virtual storage systems and installed programs, as well as limited control over the set of available services. Control and management of the main physical and virtual infrastructure of the cloud, including networks, servers, types of operating systems used, storage systems is carried out by the cloud provider. The introduction of cloud technologies makes it possible to abandon the outdated infrastructural approach to the launch of services in the field of information and communication technologies. Let's consider options for solving problems that are possible when implementing cloud technologies.

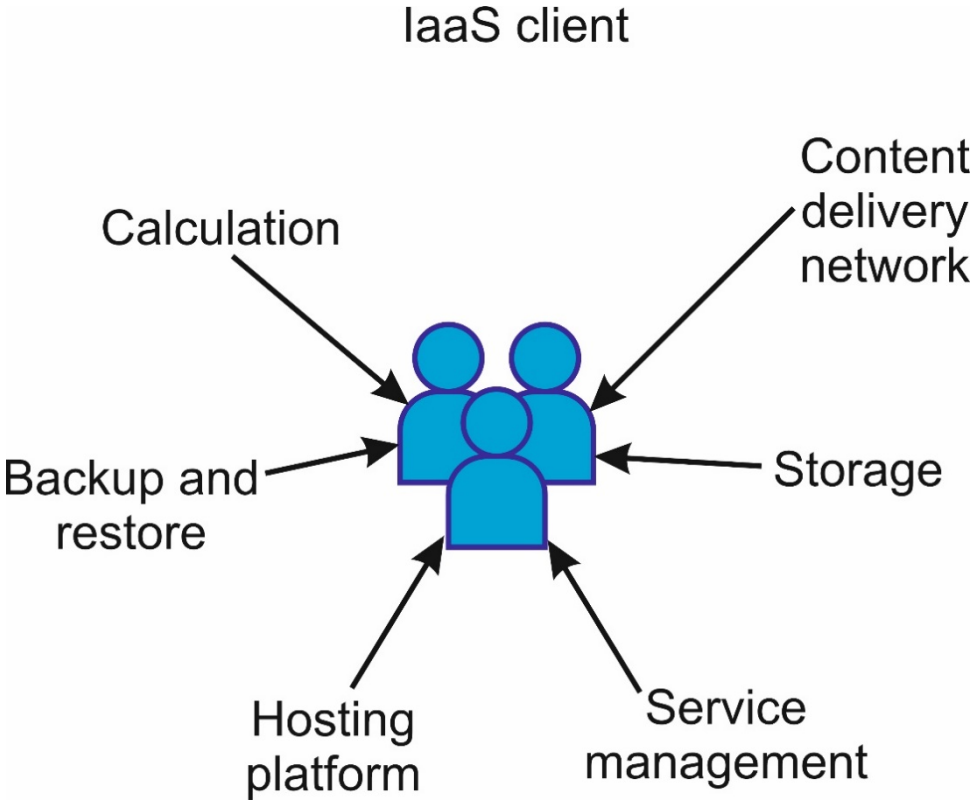
Infrastructure services (IaaS) can include a set of physical resources, such as servers, network equipment and storage, offered to customers as a service. Infrastructure services solve the problem of properly equipping the data center, providing computing power as needed. Typically, these services support infrastructure and a much larger number of consumers compared to application services. A private example of infrastructure services is hardware as a service (HaaS). As a service, the user receives equipment on the basis of which he deploys his own infrastructure using the most suitable software.

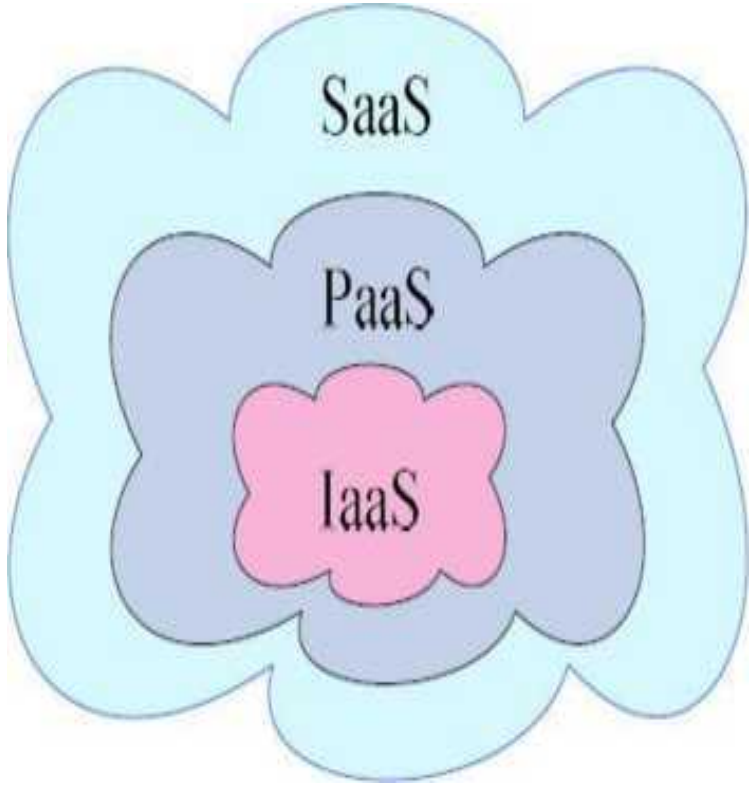
The consumer does not manage the underlying cloud infrastructure, but has control over operating systems, storage systems, deployed applications, and possibly limited control over the selection of network components (eg, a host with network screens). In this case, the protection of platforms and applications is provided by the consumer himself, and the cloud provider must organize the protection of the infrastructure. Virtualization is often used to provide resources on demand.

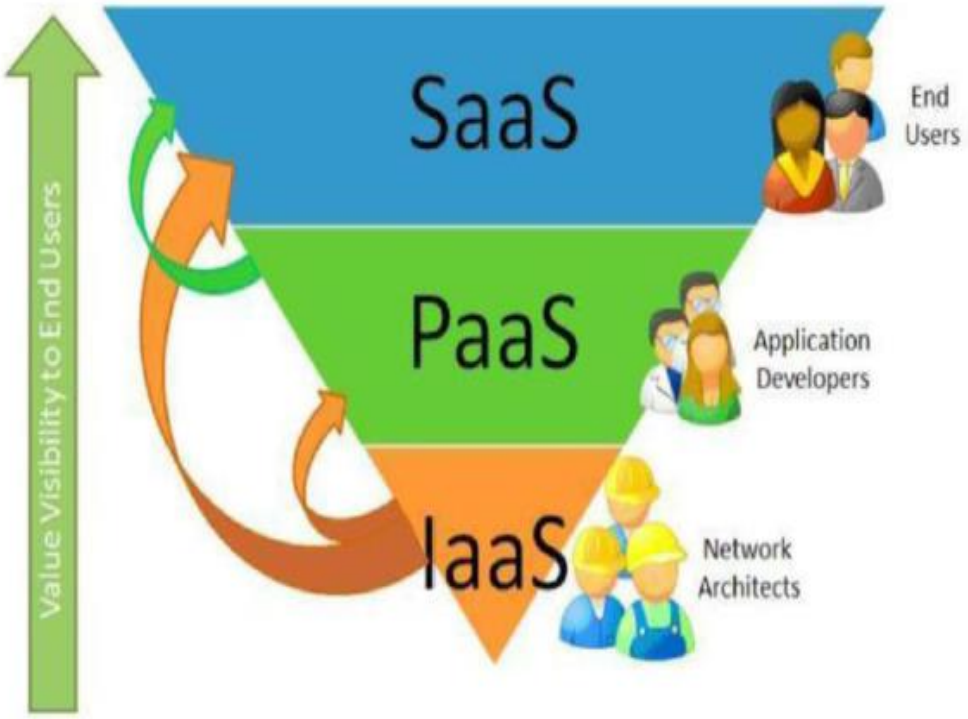
Advantages. Reduction of capital investments in hardware. Since virtualization methods are usually used in this model, savings can be achieved as a result of more efficient use of resources. Reducing the risk of investment loss and implementation threshold, the possibility of smooth automatic scaling.

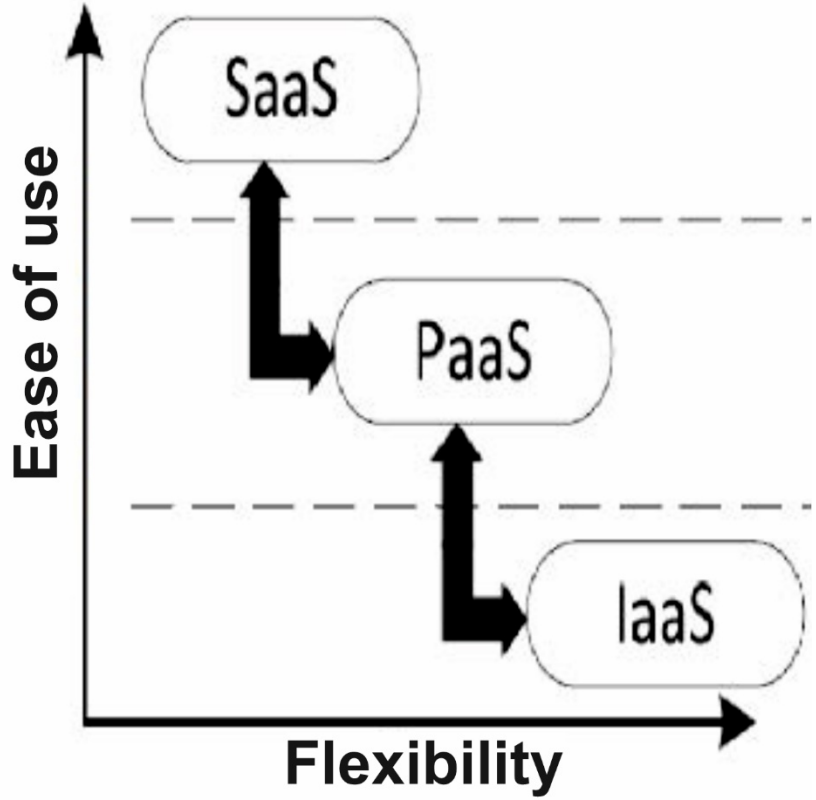
Disadvantages Business efficiency and productivity are highly dependent on supplier capabilities. Potentially large long-term costs are likely to be required. Centralization requires new approaches to security measures.

Examples of infrastructure services are IBM SmartCloud Enterprise, VMWare, Amazon EC2, Windows Azine, Google Cloud Storage, Parallels Cloud Server, and many others.






Value Visibility to End Users
SaaS
PaaS
IaaS
End Users
Application Developers
Network Architects

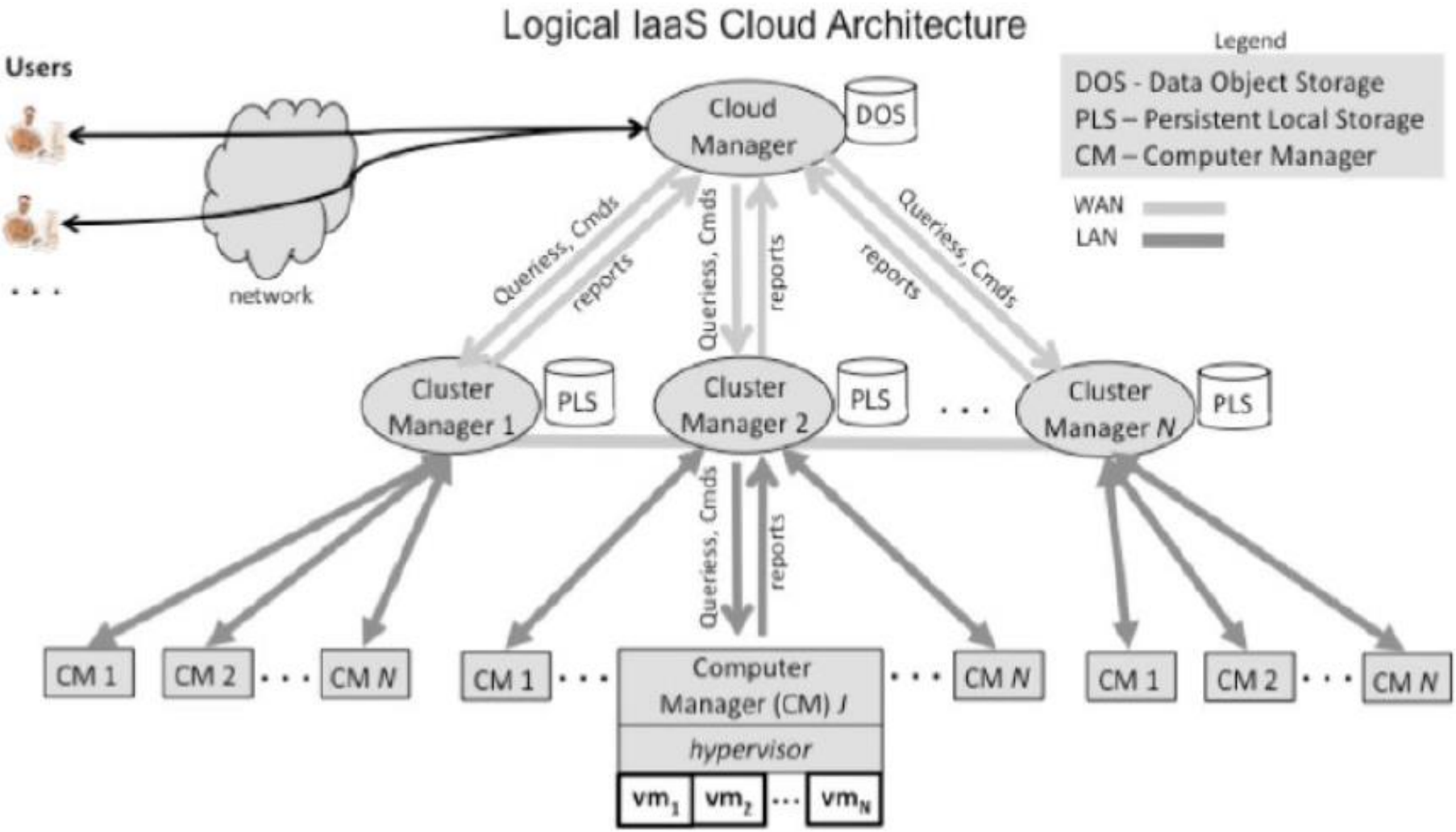

Ease of use
SaaS
PaaS
IaaS
Flexibility

A method of reducing energy consumption when designing cloud resources with the IAAS service using simulation models.

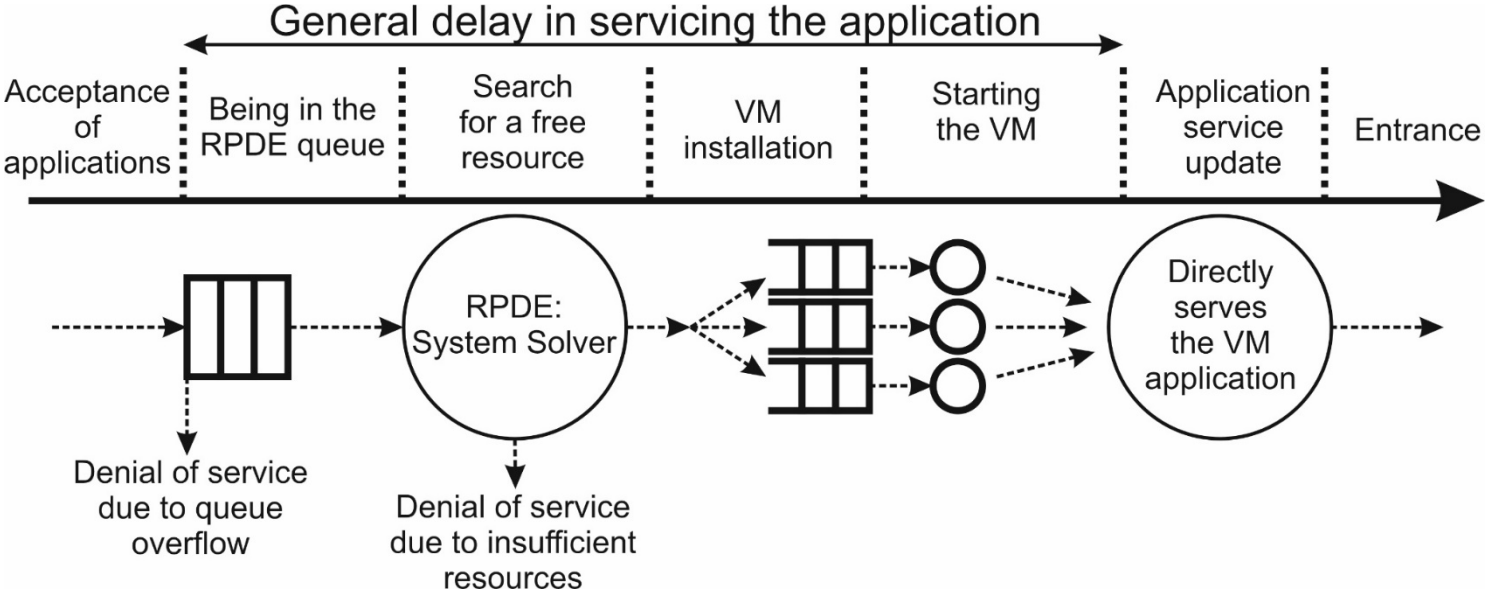
Localization of large data centers creates prerequisites for the introduction of Green - technologies for increasing the energy efficiency of computing. Cloud computing consists of thousands of servers located in datacenters that support the operation of tens of thousands of applications that are used by millions of users at the same time. Compared to the traditional approach, cloud computing allows you to manage larger infrastructures and serve different groups of users within the cloud.

Overview of cloud laaS infrastructure.

Building a cloud infrastructure that is minimal in terms of energy consumption is not possible without knowledge of the physical architecture of the data center that provides: the laaS cloud service. Figure 1 shows the physical architecture of cloud data centers with laaS service.


Logical IaaS Cloud Architecture
Users
network
Cloud Manager
DOS
Queriess, Cmds
reports
Legend
DOS - Data Object Storage
PLS – Persistent Local Storage
CM – Computer Manager
WAN
LAN
Cluster Manager 1
PLS
Cluster Manager 2
PLS
Cluster Manager N
PLS
CM 1
CM 2
CM N
Computer Manager (CM) J
hypervisor
vm1
vm2
vmN

After receiving a request for a laaS service, it enters the buffer (queue) of a special decision system (RPDE - Resource provisioning decision engine), which searches for a free resource capable of serving this request. As illustrated in the figure, two types of application service failures are possible in the system - when the queue of incoming applications of the solver system is overflowing and when physical, virtual and buffer resources of the direct application service link are insufficient. This model also considers three types of resource groups: hot, warm, and cold pools of physical servers.



The general model of application service IaaS cloud architecture.

In the hot pool, physical servers are constantly on and ready to deploy the required number of VMs on them. The physical servers of the warm pool are powered on, but they are in standby mode and are not ready for VM deployment. The physical servers of the cold pool are in a disabled state.

Thus, the general model for evaluating the quality of laaS services should include the following elements:

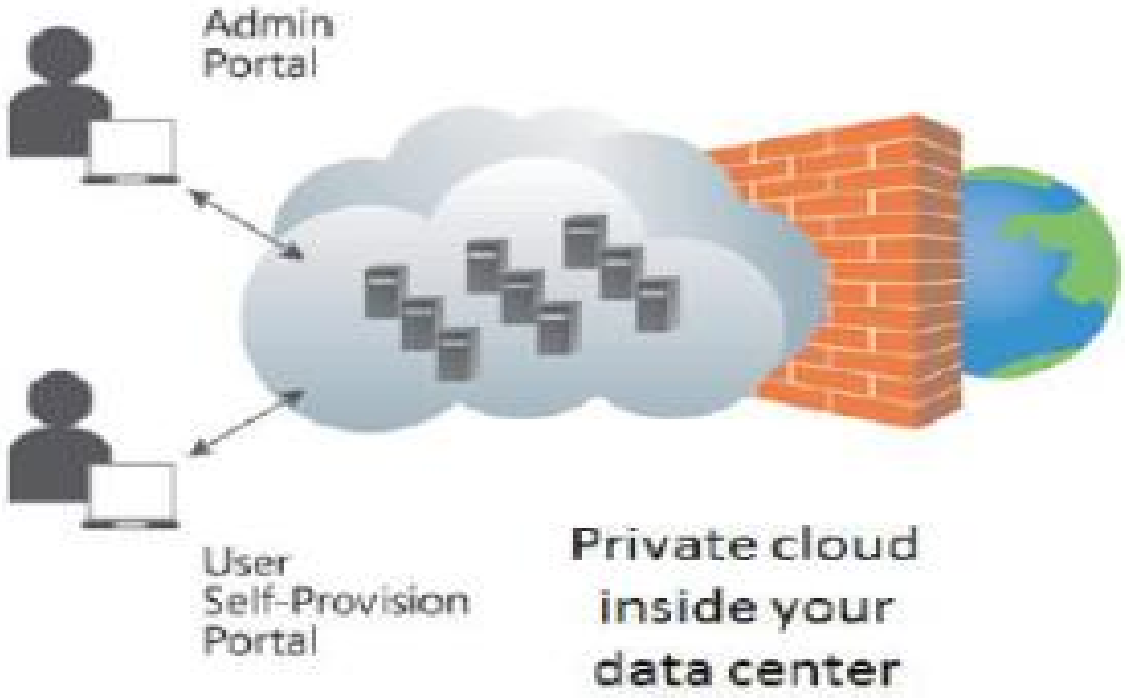
- **model of the solver system;**
- **hot pool physical server model;**
- **model of physical warm pool servers;**
- **cold pool physical servers model;**
- **direct application service model.**

Private clouds are the company's internal cloud infrastructure and services. These clouds are located within the corporate network. An organization can manage the private cloud itself or entrust this task to an external contractor. The infrastructure can be located either in the customer's premises, or at an external operator's, or partly at the customer's and partly at the operator's. The ideal version of a private cloud is a cloud deployed on the territory of an organization that serves and is controlled by its employees.

Private clouds have the same privileges as public clouds, but with one important feature: the company itself is engaged in the installation and maintenance of the cloud. The complexity and cost of building an internal cloud can be very high, and the costs of operating it can exceed the cost of using public clouds.

It should be noted that private clouds have advantages over public clouds: more detailed control over various cloud resources provides the company with any available configuration options. In addition, private clouds are ideal when you need to perform work that cannot be entrusted to the public cloud for security reasons.

Private Cloud



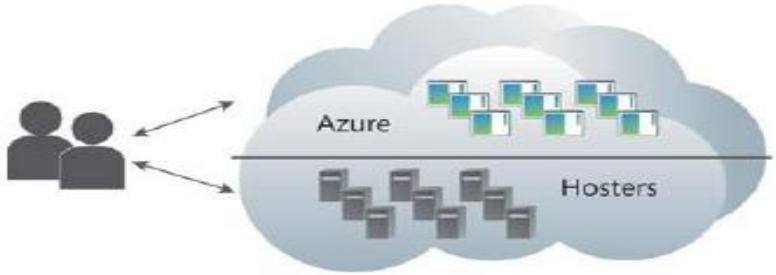
Private clouds are the company's internal cloud infrastructure and services. These clouds are located within the corporate network. An organization can manage the private cloud itself or entrust this task to an external contractor. The infrastructure can be located either in the customer's premises, or at an external operator's, or partly at the customer's and partly at the operator's. The ideal version of a private cloud is a cloud deployed on the territory of an organization that serves and is controlled by its employees.

Private clouds have the same privileges as public clouds, but with one important feature: the company itself is engaged in the installation and maintenance of the cloud. The complexity and cost of building an internal cloud can be very high, and the costs of operating it can exceed the cost of using public clouds.

It should be noted that private clouds have advantages over public clouds: more detailed control over various cloud resources provides the company with any available configuration options. In addition, private clouds are ideal when you need to perform work that cannot be entrusted to the public cloud for security reasons.

Community Cloud

Public Cloud



Public cloud by
service providers

service providers
Hybrid clouds are a combination of public and private clouds. They are usually created by the enterprise, and the responsibility for managing them is divided between the enterprise and the public cloud providers. A hybrid cloud provides services, some of which are publicly available, and some of which are private. Typically, this type of cloud is used when an organization has seasonal periods of activity. In other words, as soon as the internal IT infrastructure does not cope with current tasks, part of the capacity is transferred to the public cloud (for example, large volumes of statistical information, which in their raw form do not represent value for the enterprise), as well as to provide users with access to enterprise resources (to a private cloud) through a public cloud. A well-designed hybrid cloud can serve both security-critical processes, such as receiving payments from customers, and more secondary ones.

The main disadvantage of this type of cloud is the difficulty of effectively creating such solutions and managing them. It is necessary to receive services from various sources and organize them as if they were a single source. Interactions between private and public components can further complicate the decision. Since this is a relatively new architectural concept in the field of cloud computing, there are more and more new practical guidelines and tools for this model, and its widespread use may be delayed until it is studied.

The cloud is not only virtualization. Although virtualization of servers and infrastructure is an important foundation of private cloud computing, virtualization and management of the virtual environment itself is not yet a private cloud.

Virtualization allows for a better structure, pooling and dynamically providing infrastructure resources: servers, desktops, storage containers, network equipment, connecting software, etc. But in order for the environment to technically be considered cloud, other components are needed, such as virtual machines, operating systems or containers of connecting software, high-wall operating systems, grid computing software, software for abstracting storage resources, scaling tools and clusters from ation.

The term "private cloud," as opposed to public or hybrid, refers to resources that are used by a single organization, or means that the organization's cloud resources are completely isolated in the cloud from others.

The cloud is not necessarily a source of savings. One of the biggest misconceptions is that the cloud will save money. Savings are possible, but not a mandatory attribute.

A private cloud allows you to more efficiently reallocate resources to meet corporate requirements and can reduce capital equipment costs. But a private cloud requires an investment in automation, and the savings alone may not cover the entire cost. So, cost reduction is not the main advantage of this model. From this point of view, the main incentive for the implementation of the cloud model should not be savings, but the speed of market entry, the possibility of rapid adaptation and dynamic scaling according to demand, which allow to increase the speed of introduction of new services.

Hybrid "clouds".

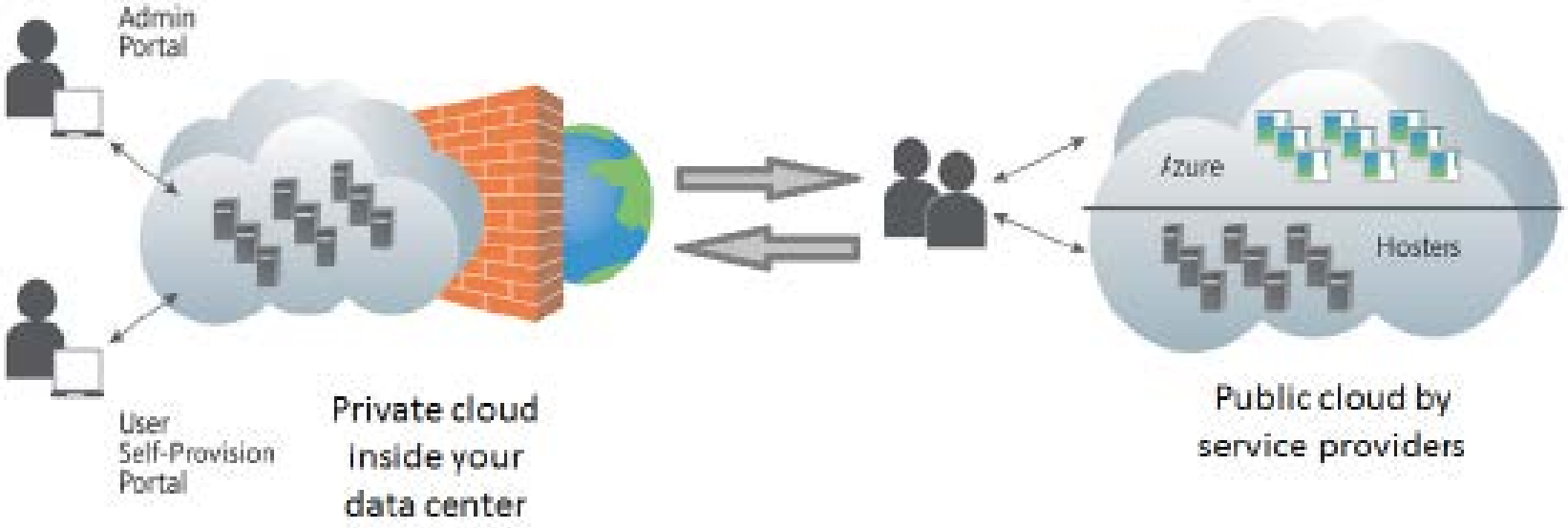
Currently, many cloud companies have begun to rebuild their strategy taking into account the "hybridization" of cloud computing.

Hybrid "clouds" are the implementation of cloud computing, in which one part of the system is placed in a public "cloud" (on the basis of the provider's centers), and the other part - in a private "cloud" (on servers belonging to the company) .

Such a "cloud" solves the problems of a lack (reservation) of the company's internal resources. Such clouds are used as an opportunity to go beyond the limits of the company's cloud capacities at peak loads. In this way, it is possible to increase the adaptability of the business without compromising security and control, since important programs can be left in a private cloud, and the rest - in the provider's cloud.

External clouds are used as a testing ground, as a temporary workspace.

Hybrid Cloud



Currently, large computing clouds consist of thousands of servers located in data centers (data centers). They provide resources for tens of thousands of applications that are used by millions of users at the same time. Cloud technology is a convenient tool for businesses that find it too expensive to maintain their own ERP. CRM or other servers that require the purchase and configuration of additional equipment.

ERP (Enterprise Resource Planning) is an organizational strategy for the integration of production and operations, labor resource management, financial management and asset management, focused on continuous balancing and optimization of enterprise resources with the help of a specialized integrated application software package, provides a common data model and processes for all spheres of the enterprise.

CRM (Customer Relationship Management) - a customer relationship management system, i.e. application software designed to automate strategies for interaction with customers (clients), in particular, to increase the level of sales, optimize marketing and improve customer service by saving information about customers and the history of relationships with them, establishment and improvement of business procedures and further analysis of results.

Due to their convenience, such cloud services as. for example, provided by Google ("Documents", "Calendar", etc.).

The reasons for the growing popularity of cloud technologies are clear: the possibilities of their application are very diverse and allow to save both on service and personnel, and on infrastructure. Hardware can be greatly simplified when processing data and storing information in remote data centers. All pi problems are almost completely transferred to the service provider.

In addition, this approach allows you to standardize software, even if different operating systems (Windows, Linux, MacOS, etc.) are installed on the company's computers. Cloud technologies make it easier to provide access to company data for both customers and own employees who are outside the office but have the ability to connect via the Internet. It is clear that using cloud computing is much more convenient. The most important disadvantage that can be immediately noticed is the complete dependence on the provider of these services. In fact, the company (user) is held hostage by the service provider and the Internet access provider. Although the reliability of cloud computing providers is increasing, a lot of effort must be made to ensure the reliability and security of data, for example, having redundant communication channels, duplicating capacities for the possibility of switching to them and, of course, thinking about the availability of information and security. In addition, cloud computing is absolutely not suitable for enterprises related to state and military secrets. No commission will issue a certificate for such a system when working with information that is not subject to disclosure.

Modern cloud technologies are not only used in ready-made network and server equipment, but also gradually penetrate the market of embedded systems (embedded cloud) and become the cause of large-scale restructuring of the market. The implementation of embedded systems leads to the placement of computer processors in such products as resource consumption counters, intelligent sensors, M2M modules, cars, household appliances, etc. This allows you to control the operation of devices, data collection and provision of interactive capabilities using a computer network connection.

The idea of connecting all kinds of devices to a global network is called the Internet of Things (IoT).

Since the number of built-in computers is increasing due to the decrease in processor prices and the widespread use of the Internet, the volume of transmitted data and subsequent processing (often in real time) is also increasing. Therefore, it can be assumed that the role of the Internet of Things and cloud computing will increase in the future.

CLOUD PRODUCTS		
Scope of applications and services	**Microsoft Office 365**	**Google G Suite**
File storage	**OneDrive**	**Drive**
Work with documents	**Word**	**Docs**
Work with tables	**Excel**	**Sheets**
Work with presentations	**PowerPoint**	**Slides**
chats and video calls	**Skype**	**Hangout**
Email	**Outlook**	**Gmail**

Comparison of Amazon, Google and Microsoft platforms.

At the moment, Amazon is considered the main provider of cloud infrastructure. Google and Microsoft. Each of the companies has a whole line of provided services. These materials describe only some of them, the most popular. Also, the question of which model to refer to this or that service and which vendors provide only public clouds, and which can take part in creating private clouds, is not discussed.

Google Drive is a cloud data storage owned by Google that allows users to store their data on servers in the cloud and share it with other users on the Internet. Google Drive has a concise interface and offers to install convenient software clients for smartphones and tablets based on the Android operating system, PCs and laptops running the Windows or MacOS operating system, iPhone and iPad mobile devices. Closer storage integration with Chrome OS and Linux support are expected in the future. Each Google Drive user receives up to 15 GB of free space for all Google services (including Gmail and Photos). At the same time, he himself can decide how much space to allocate for mail and how much space to leave for important files. You can work with files in Google Drive directly in the browser.

Amazon Simple Storage Service (Amazon S3) is an online web service offered by Amazon Web Services that provides the ability to store and retrieve any amount of data at any time from any point in the network, so-called file hosting. In March 2012, the company Nasuni conducted an experiment during which it alternately transferred a massive amount of data (12 TB) from one cloud service to another. The most rated clouds took part in the experiment: Amazon S3, Windows Azine and Rackspace. To the researchers' surprise, data transfer rates varied greatly depending on which cloud was receiving the data. The best indicator of data recording speed was found in Amazon S3, transferring data from the other two services took only 4-5 hours, while transferring data to Rackspace took just under a week, and Windows Azine took 40 hours.

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides computing power in the cloud. It gives users full control over computing resources, as well as an affordable work environment. Amazon EC2 allows users to create an Amazon Machine Image (AMI) that will contain their application, libraries, data, and associated configuration settings, or to use pre-configured image templates to run on Amazon S3. Amazon ES2 provides tools for AMI storage. Amazon S3 provides safe, reliable and fast image storage.

Windows Azure is a cloud services platform developed by Microsoft. Implements Raa and Iaa models. The platform provides the ability to develop and run applications and store data on servers located in distributed data centers.

- Windows Azine Compute - a component that implements computing on the Windows Azine platform, provides an execution environment based on a role model.

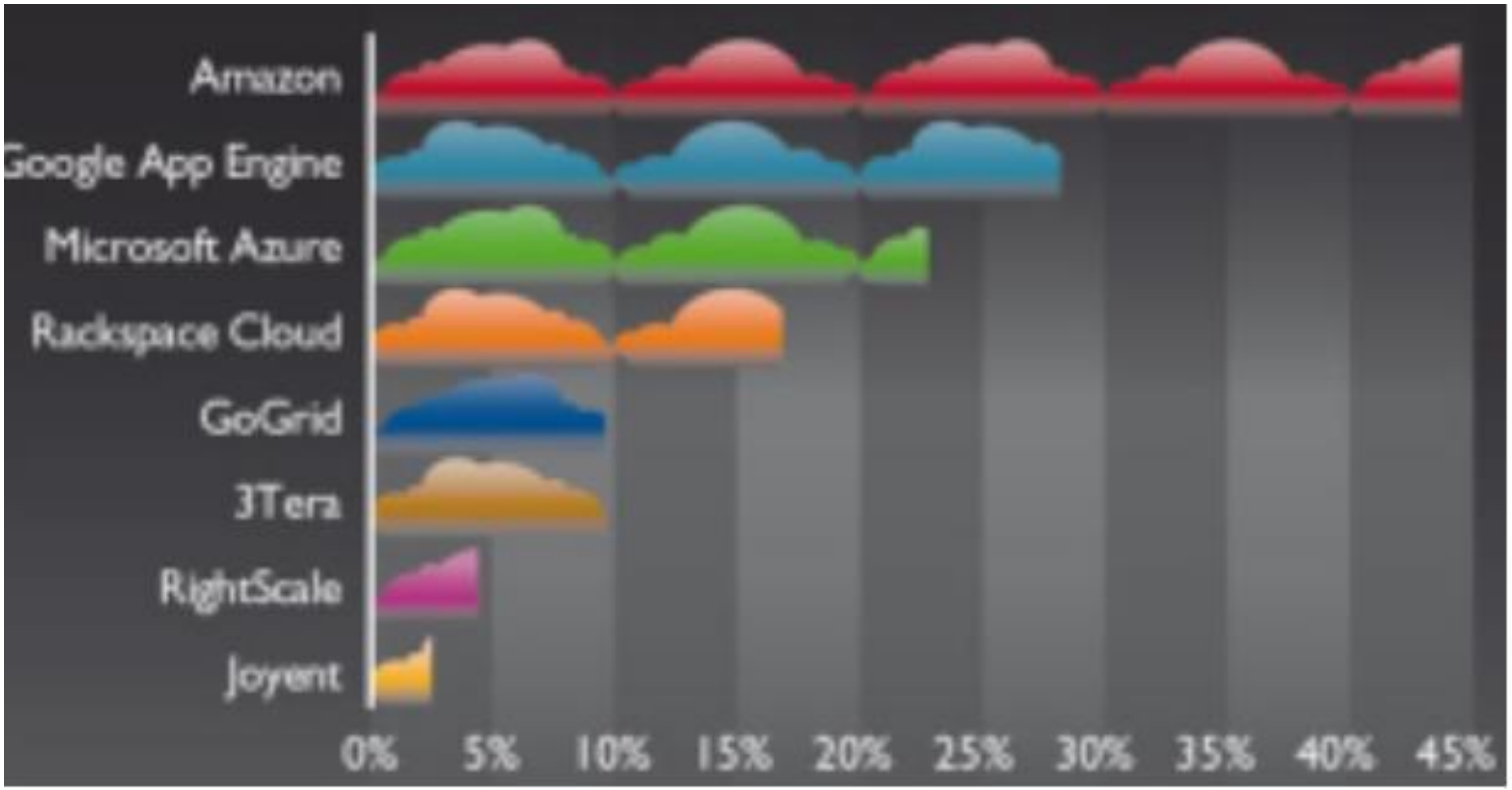
- Windows Azine Storage - a storage component that provides scalable storage. It does not have the ability to use the relational model and is an alternative (or a complementary solution) to SQL Databases (SQL Azure) - a scalable "cloud" version of SQL Server.

- Windows Azine Fabric - by its purpose is the controller and core of the platform, performing the functions of real-time monitoring, providing fault tolerance, capacity allocation, deployment of servers, virtual machines and applications, load balancing and equipment management.

The Windows Azure platform has an API built on REST. HTTP and XML, which allows developers to use cloud services with any operating system, devices and platforms.

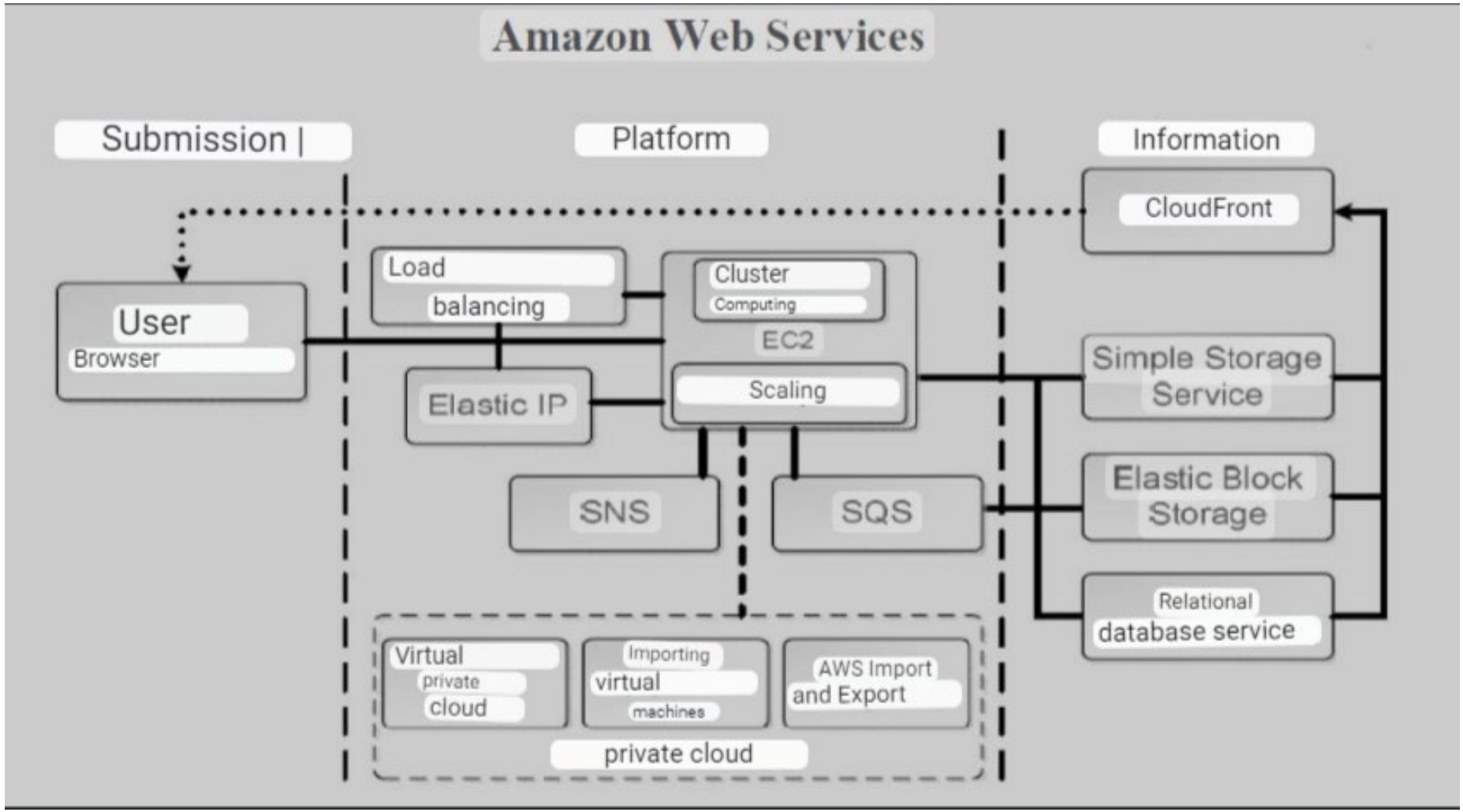
Scope of use.

Cloud technologies are used everywhere: in the public sector, production, GH companies, the financial sphere, and telecommunications. It is difficult to imagine modern life without e-mail. Google Docs, app stores and public clouds like Dropbox, Google Drive.



Cloud computing market.

The core of Amazon Web Services is the Amazon Elastic Compute Cloud (Amazon EC2) system together with storage services. EC2 provides the user with a choice of virtual machines that can be run in a distributed computing environment. A virtual machine (called Amazon Machine Image - AMI) can be based on almost any operating system (various versions of Windows and Linux distributions) and provide work with any software infrastructure (MySQL, Oracle, etc.).

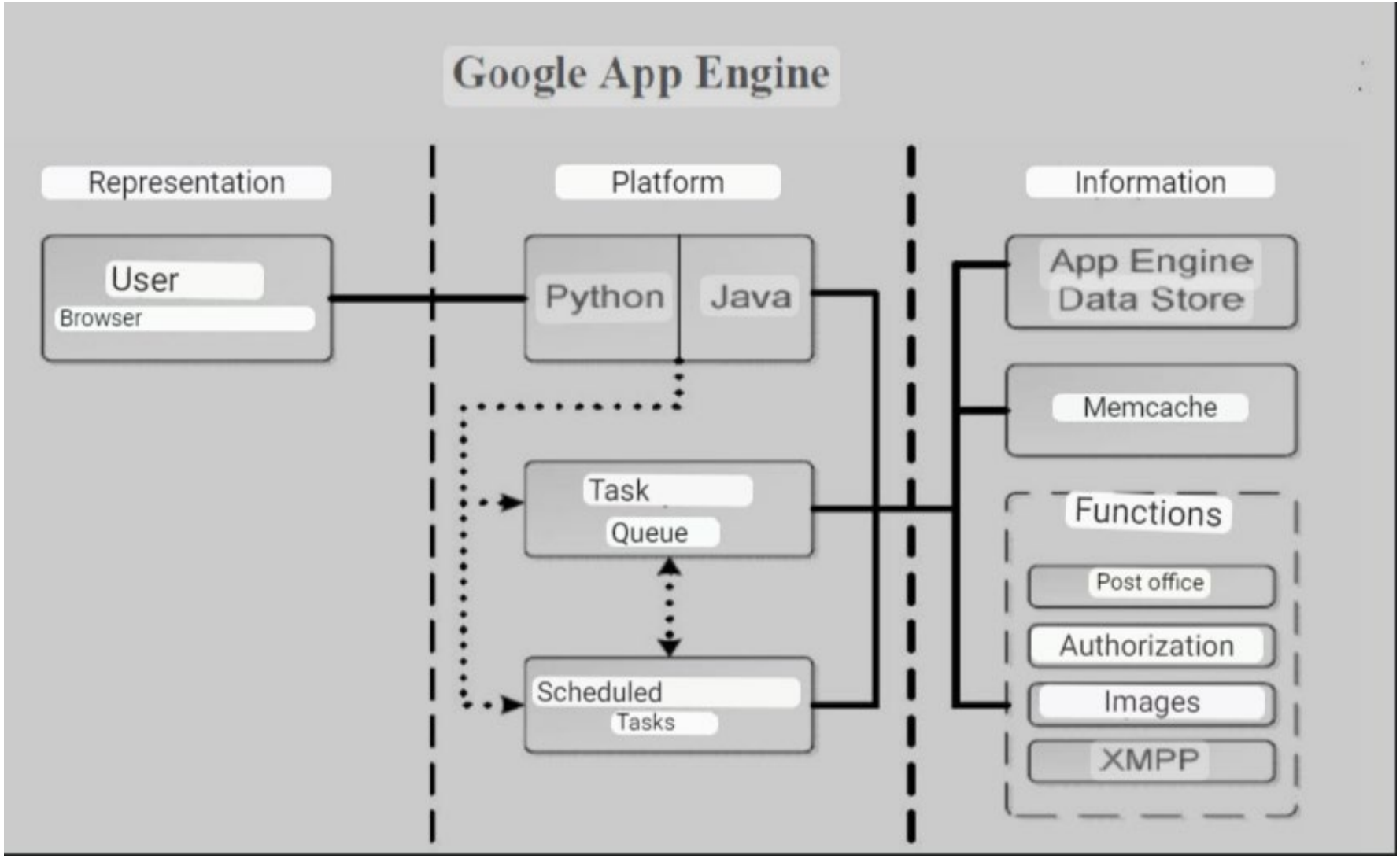

Amazon Web Services
Submission |
Platform
Information
CloudFront
User
Browser
Load
balancing
Cluster
Computing
EC2
Scaling
Elastic IP
Simple Storage
Service
SNS
SQS
Elastic Block
Storage
Relational
database service
Virtual
private
cloud
Importing
virtual
machines
AWS Import
and Export
private cloud

The user accesses the cloud application using a web browser. At the moment, Google App Engine supports Python-based development of all languages that can be executed inside the Java virtual machine (Java, Jythoin, Scala, etc.). Google App Engine developers are provided with a development tool kit (SDK), which includes a full simulation of Google App Engine on a production machine.

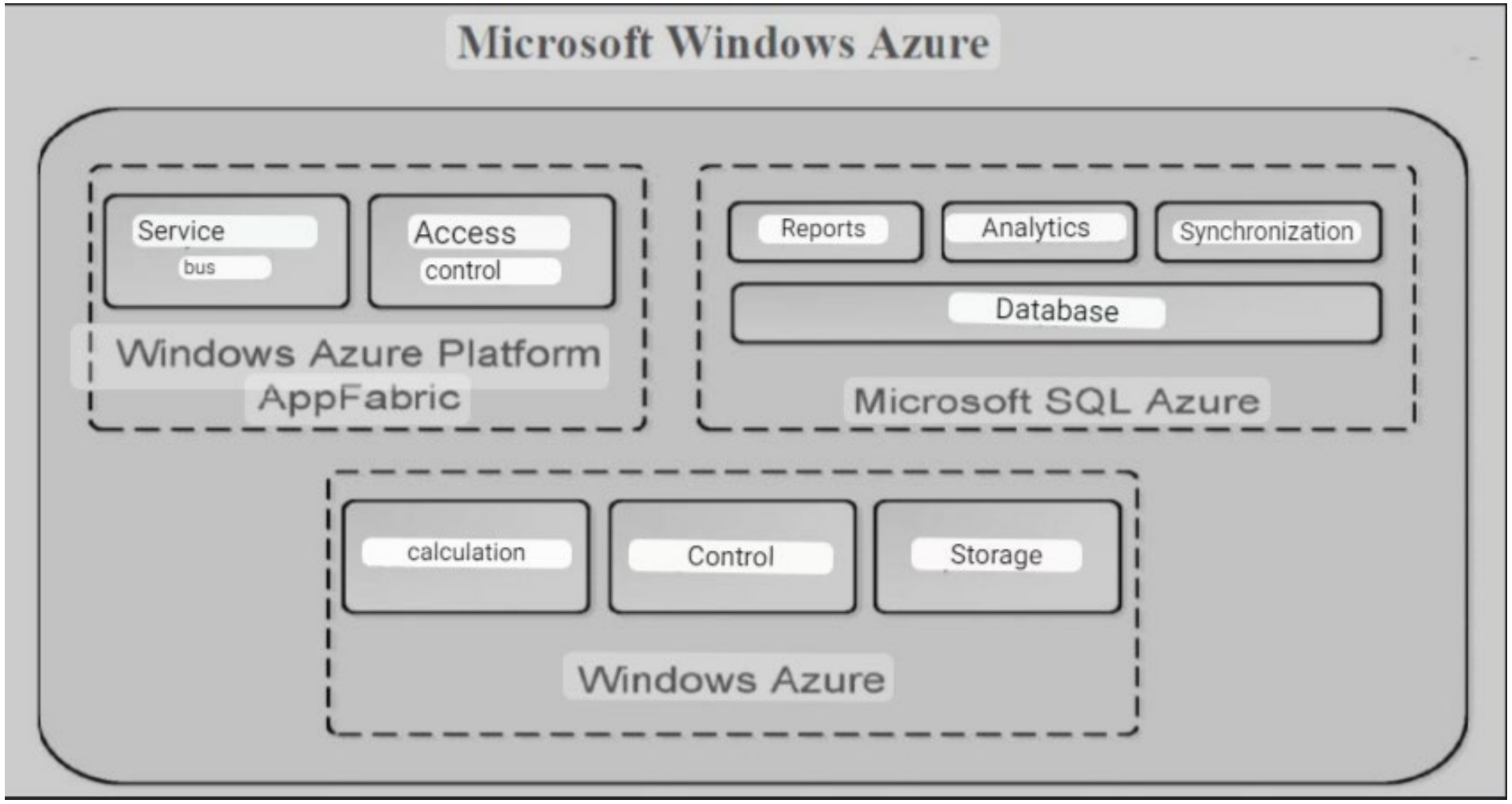
Google App Engine provides a large set of library functions to perform standard operations:

- **work with postal messages;**
- **user authorization and authentication:**
- **image processing:**
- **loading and processing of web pages;**
- **task planning;**
- **data processing using MapReduce (a distributed computing model used for parallel computing on very large data sets in computer clusters);**
- **storage of larger (up to 2 GB) volumes of information;**
- **messaging based on Jabber (Extensible Messaging and Presence Protocol - based on XML. an open, free-to-use protocol for instant messaging and presence information in near-real-time mode).**

Google App Engine makes it possible to provide a high-performance service without significant infrastructure costs.


Google App Engine
Representation
Platform
Information
User
Browser
Python
Java
App Engine
Data Store
Memcache
Task
Queue
Functions
Post office
Authorization
Images
XMPP
Scheduled
Tasks

The Windows Azure platform allows you to run applications developed on the basis of the Microsoft.NET platform on Microsoft servers, providing automatic management of computing resources, load balancing and data replication. Developer access to the platform is carried out using tools integrated into the latest versions of Visual Studio (Windows AzureSDK, Windows Azure Tools for MVS). At the same time, the possibility of local testing of applications before their publication on the Azure service is supported.


Microsoft Windows Azure
Service
bus
Access
control
Windows Azure Platform
AppFabric
Reports
Analytics
Synchronization
Database
Microsoft SQL Azure
calculation
Control
Storage
Windows Azure

The basis of modern cloud computing was service-oriented architecture (Service-Oriented Architecture, SOA), provision of applications in service mode (Application Service Provider. ASP), etc.

The Open Group SOA Reference Architecture standard (SOA RA reference architecture) provides recommendations and options for architecture, design and implementation of solutions when creating architectures of service-oriented solutions, including cloud computing architectures. The goal of the Open Group SOA Reference Architecture standard is to provide a prototype for architecture creation and evaluation. Microsoft and IBM develop the concept of service-oriented architecture in recommendations for designing information systems on software platforms.

SOA is a component interaction model that connects various functional application modules (services) with each other using clearly defined interfaces. One of the well-known integration templates is "Service". The interface does not depend on the used hardware platforms, operating systems or programming languages used to develop these applications. This allows individual services to interact with each other in the same standard, but at the same time universal way. This feature of using an environment- and platform-independent interface is called the "weak link" model. Its advantage is increased flexibility and adaptability, since the replacement or modernization of one of the system components does not affect the others.

Modern approaches to SOA implementation cover the technological level of data exchange and the level of business operations. In particular, one of the important results was the development of a specialized BPEL (Business Process Executable Language for Web Services) language for describing aspects of the interaction of various services from the point of view of implementing business rules. The adoption of SOA as a target architecture implies an appropriate approach to application development (SODA - service-oriented development architecture).

For e-business tasks, SOA functionality is implemented at the level of web services (services). Web service - software systems that use XML as a data format, Web Services Description Language (WSDL) standards for describing their interfaces, Simple Object Access Protocol (SOAP) for describing the format of received and sent messages, and the Universal Description, Discovery and Integration standard (UDDI) to create catalogs of available services.

The service-oriented model should be extensible: the user should be able to add new services or change the set of available services. Users must also be able to access services via the network from devices of various capabilities - desktop machines, mobile devices, etc.

SOA is supported in many modern software tools, including: Microsoft SharePoint - a tool for creating extensible Web pages and Web services: UDDI (Universal Discovery, Description and Integration) - a technology for publishing and searching Web services (Microsoft).

Service-oriented architecture is an approach to software development based on the use of services (services) with standardized interfaces. The service interface is described using a formal language-independent platform, such as WSDL (Web Service Definition Language). This approach allows integrating the logic and resources of previously created information systems to solve new tasks.

The spread of high-speed Internet communication channels has made possible intensive data exchange with computers located in the "cloud".