

CLOUD COMPUTING

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Abstract: *With development cloud computing, organizations around the world prefer to invest in a small local infrastructure, focusing an infrastructure as a cloud service. The characteristics pursued by customers when choosing between various cloud infrastructures, as a service provider, are: cost-effectiveness, reliability, security and performance. The customer is given access to the virtualized component in order to build their own IT platforms. The concept of cloud is used in the interest of the very large corporations and in all institutions, research centers and government agencies, companies. Infrastructure as a Service (IaaS) is one of three basic service models of cloud computing with Platform as a Service (PaaS) and Software as a Service (SaaS). Like all cloud computing services, providing access to computing resources in a virtualized environment through the Internet. Communities cyber criminals are very interested to study and exploit the direct and indirect risks of cloud implementations, hoping to collect a lot of data and information that can bring direct and indirect benefits or income.*

Keywords: *IaaS, SaaS, PaasS, Cloud, Security.*

JEL Classification: *L86, L96, M15.*

1. Introduction

2006 is the year that announced the first available cloud service companies. Since then, the growth of cloud computing has begun, which is characterized by unlimited theoretical computing power, wherever access and collaboration is at a level that has a direct impact on the efficiency of IT departments by changing the way they conduct business in general, through access faster to the company's information resources. Some companies are important players in the cloud market such as: Amazon, Microsoft, Google, IBM etc. Cloud computing can be defined as follows: cloud computing allows cloud service providers and consumers to establish an initial set of management, security and interoperability expectations and determine a fair value generated by the use of cloud technology.

Important features of the cloud infrastructure include: automated on-demand service, broadband network access, shared resources, rapid flexibility, and tools to measure the quality of services provided. Access to the cloud is competitively allowed to a large number of consumers through virtualized technologies with automated auto-scaling and forecasting functions depending on the number of processing requests. Theoretically, the amount of processing and storage resources that a user can benefit from is unlimited. Figure 1 summarizes the definition of cloud computing presented above.

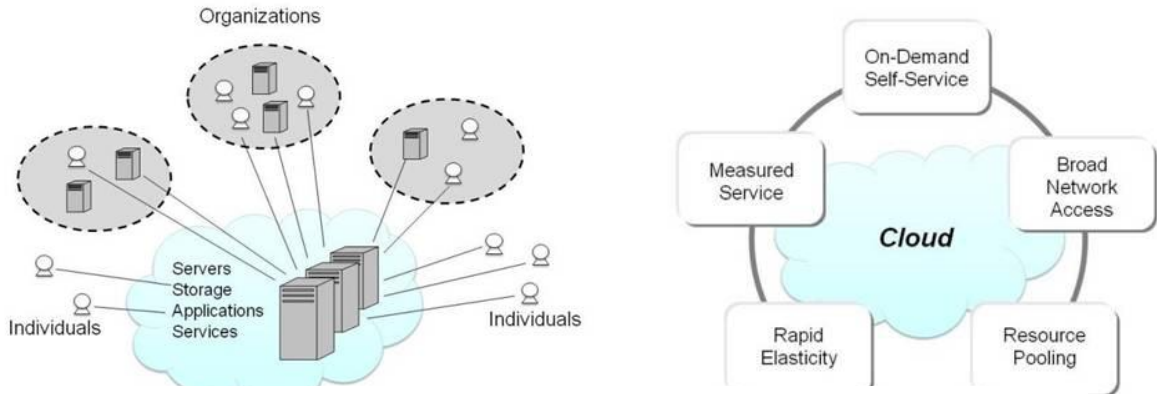


Figure 1. Basic Cloud Computing Model / The Essential Characteristics of Cloud Computing

Source: http://www.opengroup.org/cloud/cloud_for_business/p1.htm

2. Cloud computing implementation models

The concept of cloud is used in the interest of large software companies, but of very large corporations as well as in any institution, research center and government agencies or companies.

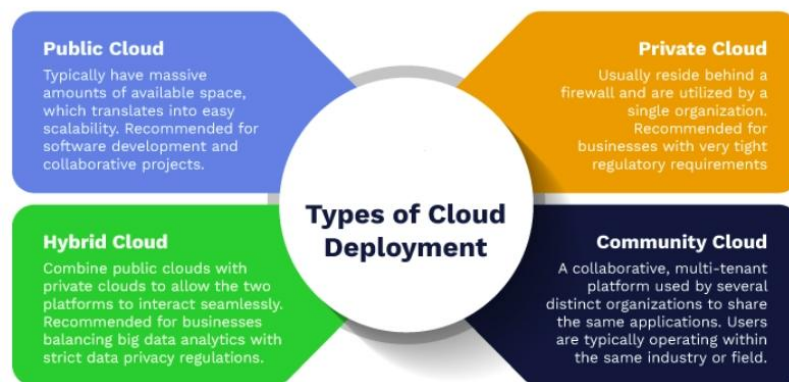


Figure 2. Type of cloud development

Source: http://www.opengroup.org/cloud/cloud_for_business/p1.htm

- **Public cloud** - represents the investments of large software companies and intended for global consumers regardless of size and field of activity. Apple, Google, and Microsoft are the largest providers of public cloud for mobile devices, storage, and application purchases, and Google and Microsoft are offering free Office document creation and processing application packages to customers;

Table 1. Worldwide Public Cloud Services Forecast (Millions of Dollars)

	2016	2017	2018	2019	2020
Cloud Business Process Services (BPaaS)	40,812	43,772	47,556	51,652	56,176
Cloud Application Infrastructure Services (PaaS)	7,169	8,851	10,616	12,580	14,798
Cloud Application Services (SaaS)	38,567	46,331	55,143	64,870	75,734
Cloud Management and Security Services	7,150	8,768	10,427	12,159	14,004
Cloud System Infrastructure Services (IaaS)	25,290	34,603	45,559	57,897	71,552
Cloud Advertising	90,257	104,516	118,520	133,566	151,091
Total Market	209,244	246,841	287,820	332,723	383,355

Source: Gartner (February 2017)

- **Private cloud** - represents the investments of a company or a conglomerate of companies, intended largely exclusively for consumers within the company. Examples of solutions for creating private clouds are: System Center - Microsoft; IBM Cloud - IBM; CloudPlatform - Citrix; vCloud Suite - VMware; Cloud Forms - Red Hat;

- **Hybrid cloud** - involves the use of services offered by the public cloud interconnected with internal information entities, intended mostly for very large companies and aims to expand internal processing capacity in order to serve consumers within the company. The disadvantages of the hybrid cloud are related to: the transfer of company data beyond the "border" of firewalls, the large volume of data that are transferred through public Internet networks, which leads to increased costs of Internet access and the risk of being intercepted by the places they pass through, ultimately causing high implementation and management costs.

- **Community cloud** - involves the joint sharing of resources of a group of organizations within the same field of economic and social activity. This type of model is organized as a virtual data center where the community cloud is technically implemented by sharing unused resources of community members' computers.

3. Cloud service models

All cloud computing services provide access to computing resources in a virtualized environment through the Internet. The difference between the on-premises model and cloud computing are presented in figure 3.

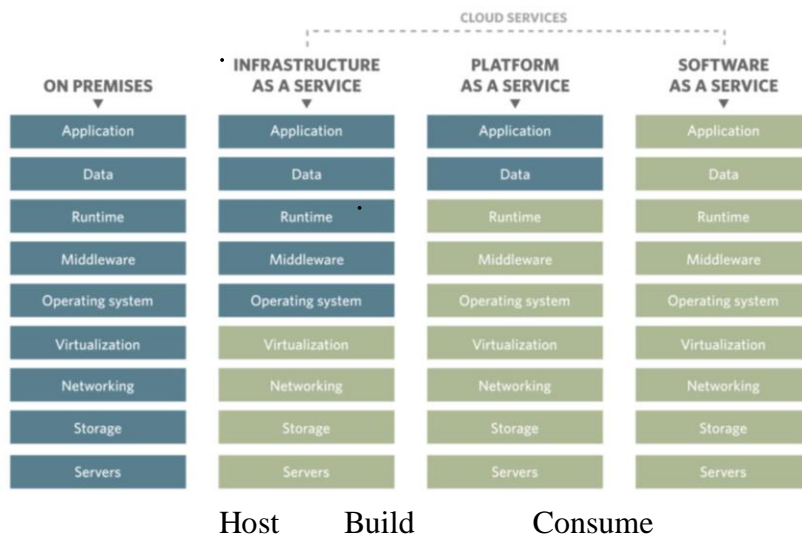


Figure 3. Types of cloud services

a. Characteristics of the IaaS Model

IaaS is one of the newest cloud service models and allows customers to create their own computer infrastructures, network and storage equipment. The client has the possibility to build his own IT platforms, to configure: the equipment by specifying the number of processors, of their type; the amount of RAM allocated; the size of the storage space and how to connect to the network. In this way the computing resources provided are specifically the virtualized hardware resources. IaaS offers can include facilities such as: virtual space on the server, network connections, bandwidth, IP addresses, etc. From a physical point of view, hardware resources are accessed from a multitude of servers and networks usually distributed in numerous data centers, for the maintenance of which the IaaS service provider is responsible. The main providers of IaaS are: Amazon (AWS), Microsoft (Azure), Google (Cloud Platform) etc.

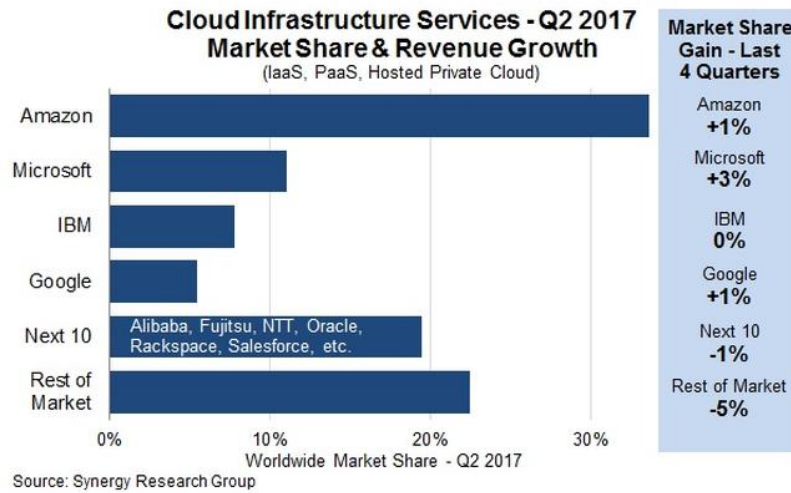
b. Characteristics of the PaaS Model

PaaS is one of the most complex models of cloud services because it is a suite of applications and services designed to build other applications and services, offering developers specific sets of APIs. Thus, developers do not need to install and configure their own processing servers (middleware), databases or web servers. The services delivered by PaaS providers are classified as follows: application development; collaboration (tools that ensure the integration of teams); data management (through database-specific tools); testing and performance tools (intended for the analysis of applications implemented in order to optimize resource consumption); storage space (applications that manage data stored in the cloud in database format, files that are integrated into hybrid cloud architectures to ensure the persistence of historical data in the company's computing center); transaction management (transaction management tools or transaction integrity brokerage services).

c. Characteristics of the SaaS Model

SaaS is one of the most used models of cloud services in that it allows a large number of users to benefit from a set of specific applications, standardized and necessary in carrying out current activities. Access to applications is through web browsers or through dedicated client applications (eg Outlook, Skype, DropBox, Google Drive, etc.). Information services offered in the cloud in the form of SaaS are: project and portfolio management; business intelligence and data warehouse; training management; geographic

informatics systems; mobile device management; ERP; human resources management; supply and distribution chain management; activity management; documents management.



Infrastructure as a Service (IaaS) provides the following features and benefits:

- **Scalability.** The resource is available when / how the client needs it.
- **No hardware investment is required.** The physical hardware which provides the basis for IaaS services is configured and maintained by the cloud service provider.
- **Utility style costs.** The service can be accessed on request, and the customer pays for the resource actually used.
- **Independence from the location.** The service can generally be accessed from anywhere, as long as there is an internet connection, and the security protocol of the cloud service allows it.
- **Physical security for data center locations.** Services available through a public or private cloud hosted externally by the cloud service provider benefit from the physical security specific to servers hosted in a data center.
- **No faults.** If a server or other network element fails, the service is not affected because there are countless / many hardware resources as well as a configuration redundancy.

4. Cloud security

The permanent concern about cloud computing is linked in security and privacy in the cloud, because company data or persons data resident on computers of other companies which triggers suspicions regarding access. In general, the main vulnerabilities that companies or individuals are exposed when accessing cloud technologies are:

- **Cloud connection vulnerabilities.** Because methods of connecting to cloud services include specific browsers and applications, customers need to ensure that they are protected and secured.
- **Data and communications encryption.** Each cloud service transfers data through secure channels: HTTPS, SSH, RDP, FTPS, but it is up to the customer to ensure when connecting that they access the correct site for authentication.
- **Physical location protection** is a concrete security requirement for the location of the client using cloud services.
- **Risks related to performance and functionality.** Customers need to be sure that when choosing a cloud service that they have tested the performance of the service well enough and that the functionalities correspond to the specifics of the company's processes / business flow.

- **Exposure to social engineering attacks.** Although cloud protection mechanisms make it difficult or minimize traditional attacks, cybercriminals are looking for other ways to gain access to companies' information content.

America's cloud security standards define several specific classes of controls to determine the level of vulnerability of a service, for example: configuration management; acquisition of systems / services; protection of systems and communications; systems and information integration. Thus, each class of controls has its own specific categories of risks and vulnerabilities generally applicable to information systems, including cloud architectures.

5. Conclusion

Cloud computing is a business model that brings consistent financial benefits to intermediary companies in the distribution of cloud services and has: a rate of adoption of cloud computing services in a continuous increase; the decision to choose the cloud service provider is based on objective factors (low IT budgets) the company's data security; data availability; simplicity in use and freedom to choose / change the supplier; Software as a Service (SaaS) and Platform as a Service (PaaS) services are increasingly sought after and adopted among users; software applications must be developed so that they can be implemented in the cloud, simple and fast, and the hybrid cloud will be the service model chosen by enterprise-type companies. The more technology-dependent or integrated life generally becomes, the greater the associated risks. Thus, the Internet of Things (IoT) will create new vulnerabilities and security demands related to the physical and digital environment. However, the concern in the field of interconnecting the real world with the virtual world offers almost unlimited possibilities and directions.

References:

1. Data Flair, 2020. *Features of Cloud Computing – 10 Major Characteristics of Cloud Computing*. [online] Available at: <<https://data-flair.training/blogs/features-of-cloud-computing/>> [Accessed 12 May 2020].
2. Felter, B., 2020. *The Different Types of Cloud Computing and How They Differ*. Vxchnge. [online] Available at: <<https://www.vxchnge.com/blog/different-types-of-cloud-computing>> [Accessed 12 May 2020].
3. Gour, R., 2019. *9 Major Characteristics of Cloud Computing*. Dzone. [online] Available at: <<https://dzone.com/articles/9-major-characteristics-of-cloud-computing>> [Accessed 12 May 2020].
4. Mell, P. And Grance, T., 2011. *The NIST Definition of Cloud Computing*. [online] Available at: <<https://csrc.nist.gov/publications/detail/sp/800-145/final>> [Accessed 12 May 2020].
5. Ranger, S., 2018. *What is cloud computing? Everything you need to know about the cloud explained*. [online] Available at: <<https://www.zdnet.com/article/what-is-cloud-computing-everything-you-need-to-know-about-the-cloud/>> [Accessed 12 May 2020].
6. The Open Group, 2020. *Cloud Computing for Business – What is Cloud?* [online] Available at: <http://www.opengroup.org/cloud/cloud_for_business/p1.htm> [Accessed 12 May 2020].