

Modern Paradigm and Trend in Cloud Computing

Danko Naydenov

Abstract – *Recently, a new technology, the Cloud Computing, is gaining popularity. The reason for gathering more and more supporters is the advantages it offers, e.g.: a full use of the computer resources, an increase in the economic result through an increased utilization, an increased system reliability, a lower power consumption.*

Keywords: *Cloud Computing, IaaS, PaaS, SaaS*

To understand more easily what cloud computing is, there will be a parallel review between the On-Premises application and the Cloud application. For this purpose, first we will look at a typical structure of the on-premises application.

Each application is considered to consist of three main layers:

- **Basis** – almost any application using an existing software for the machine on which it operates. These are usually operating system and its functions and standard libraries that are treated as local support. Historically, this is the first stage in the development of computing. Examples of operating systems can provide Windows-based operating systems of Microsoft, as an alternative are different distributions of Linux, but for more complex computing machines versions of Unix are used. Examples of systems for local support can be given .NET Framework technology of Microsoft or Java platform and with the help of these two technologies can be developed from small and simple applications to large complex and WEB based applications.
- **Infrastructure** - with development of the computing, some part of the application is carried on specialized machines. This process began in the 80s and 90s of twentieth century. As an example of infrastructure services different types of databases can be given. For those databases, most often dedicated server on which they operate, and other applications are accessing data through the network from another computer.
- **Applications as services** – with the creation of more complex applications, most of them share some of their functionality that can be used by other applications. These are the current trends in computing. Applications that share their functionality can be considered as individually designed for a very specific area and other developed by large companies with a wider scope.

Such described triple layer structure for the on-premises application was also observed in cloud applications. However, it should be noted that although there are similarities in the structure of an on-premises and cloud application, they are designed for different purposes, especially in the way they serve to users. In the on-premises application, the number of enterprise users is limited, while the cloud application can be expanded since it works in a Web environment.

Both the on-premises applications' basis, as well as the cloud applications' basis provide basic functions for the operation of the application. A typical example of cloud operating system is Elastic Compute Cloud (EC2) of Amazon. EC2 is a modified Linux that runs on a virtual machine. Developers are free to install whatever software they want and libraries on this instance.

In infrastructure, things are slightly different. If on-premises application chooses to use Java, this does not limit it to use certain database, such as MySQL. This is not true for cloud applications. Most cloud providers offer own solution to store data and there is a good reason for this. This is scalability and to achieve this goal, it is necessary that

providers have the ability and freedom to optimize the system for storing data [4]. Cloud applications also share their functionality, so they can be used by other applications. For example, search engines provide access to their search functionality, so that other applications can benefit from it. Another example of sharing cloud application's functionality is mapping. For example, real estates, tourist attractions, shops want to show their locations, but the developers either do not have enough budget or resources to make their own system of mapping. In such cases, it is command to used cloud applications sharing such functionality.

There are several reasons for cloud computing to gain popularity:

- Rate of load of computers [1]

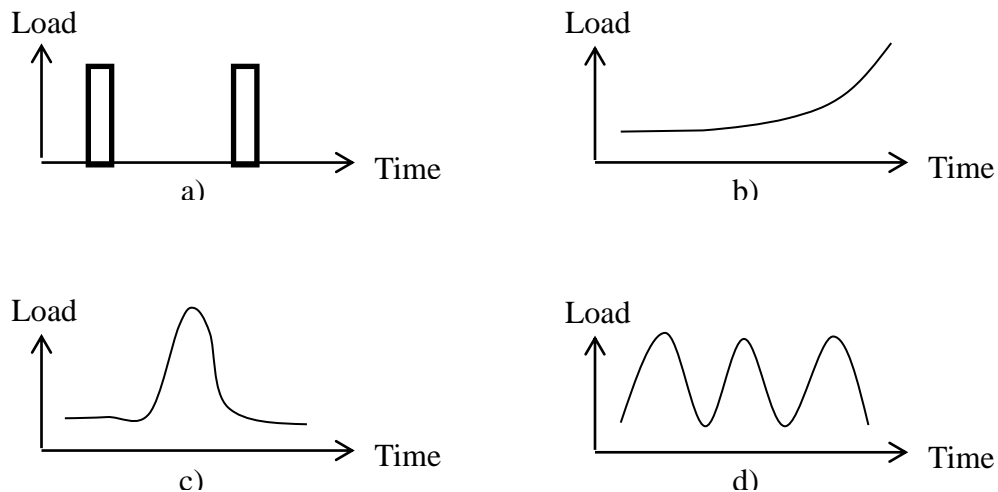


Figure 1: Computer load

In most cases, computers are loaded only at 10% -15% of the time. In the rest of the time, they perform computing tasks, but only to support the operating system. Example of this situation is a computer that runs batch job (Figure 1a).

Another situation where we have inefficient use of computing resources is when it is expected the load gradually increases over time and need to provide computing resources to meet this future workload. In this case, a large initial investment is needed, and one does not know when exactly the resources will be fully loaded (Figure 1b).

A third situation, in which there is a problem with the computing resources, is when there is a peak load at some point. An example is a large public event which will lead to a big interest for information - such as elections for Parliament (Figure 1c).

The last situation which leads to inefficient use of resources is when there is a recurrent load. Examples are different sport events that take place weekly (Figure 1d).

In all these situations there is an inefficient utilization (idle) of computing resources. Cloud computing provides an appropriate solution for this. The key feature here is that users pay only for used resources. In other words, the cloud environment applications can request CPU resources, use them and after completion of the task, the resources can be released, and the payment is only for the time and the size of the used resource. This key feature of the cloud computing solves the resources problems since it does not require an initial investment of purchasing servers and there are no costs for their maintenance, while there is a scope for expansion of the environment.

- In recent years, there has been a considerable development in computing, which leads to an increased need for more space for storage, which leads to increased costs. It also increases the energy consumption of computers and other peripherals.

- Striving to reduce the initial investment and subsequent maintenance costs of a technique such as server administration, maintenance of network devices, need for updating their software, problems as a result of possible loss of data or problems with viruses. All these problems can also be solved with the use of cloud computing.

It is difficult to give an exact definition of what cloud computing is. This is an attempt to briefly describe it.

Cloud computing is a remote and distributed dynamic set of virtual computing resources available over the Internet, which provides an environment for deployment and execution of applications. Basically, cloud computing represents distributed computing environments from which applications can request and use resources and after completion of the work, the resources can be released.

Although it is difficult to give a precise definition of cloud computing, there is an agreement about what types of services are available [2]:

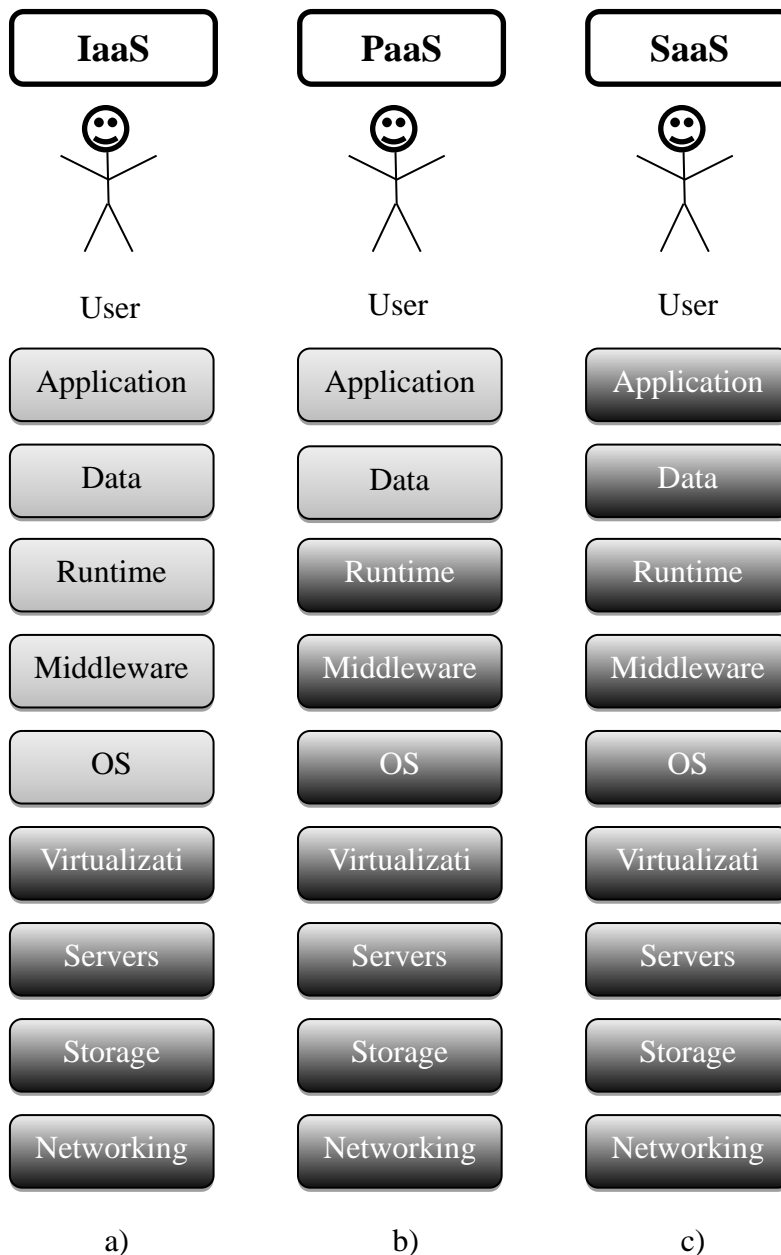


Figure 2: Layering of the cloud service

- Infrastructure as a Service (IaaS) – customers of such type of providers normally gain access to diverse types of infrastructure. In general, IaaS providers hold a very large physical infrastructure which is divided into smaller virtual resources, which are accessible to customers. This type of service can be provided as a raw virtual machine, or as a simple storage. Most completely solution is to be provide virtual machine(s) with operating system and possibility for multiplication. As it can be seen, this type of service includes layers from networking to virtualization (Figure 2a).
- Platform as a Service (PaaS) – such providers commonly extend existing IaaS by appending middleware. The additional software representing this middleware is commonly a Data Base software, or some type of run time environments such as Java Runtime Environment (JRE) or a web server. Using this extension software, more sophisticated applications can be started. This type of service includes layers from networking to runtime (Figure 2b).
- Software as a Service (SaaS) – customers of such providers typically receive a rich web interface. Normally, users are completely separated from the application that runs behind the interface. Providers of such type of service can easily inspect the load and if the additional calculation or data resources are required, providers can increase the number of machines in the cluster. This service includes all layers from networking to application (Figure 2c).

There are several approaches used for developing and use of the cloud computing:

- First, cloud vendors provide an environment that is used by developers to create new applications. In this case, direct users are developers, not end users.
- Second, an on-premises application uses a functionality provided by the cloud. A typical example is iTunes of Apple. This is a desktop application used for playing music and movies, but it also allows access to the cloud where it is possible to purchase movies and music.
- Third, providing a complete solution of service from a cloud provider. In this case, the end-user uses a small program on his computer or mobile device (typically a web browser) and accesses the service, which is located entirely in the cloud.

Unfortunately, cloud computing has also some deficiencies.

First, the issue of security. There are many cloud applications that store information about customer accounts, tax information, e-mails, health data etc. Everyone is sensitive to such type of data and when these data are not under their control, different doubts may appear [3].

Second, cloud vendors charge the usage of a resource. This means that whether the resource has been loaded or not when it was reserved, users have to pay for it. Moreover, if for some reason a resource is used inappropriate or unwanted (malicious access to the application) then again one has to pay for it.

Since cloud computing is a new technology and it develops very dynamically, these deficiencies will probably find their solution in the near future.

Conclusion: In the field of computing, cloud computing is a rarely seen new technology. However, when a new technology is successful, it gives a great impetus to the development of applications. Although cloud computing can still not fully replace the on-premises applications, it attracts the attention of more and more people. The main reasons for this are: its ability to scale, its high reliability and the low maintenance costs. In a conclusion, everyone working in the field of software development should expect cloud computing increasingly entering as a platform for creating applications.

References:

- [1] Dominique Bellenger, Jens Bertram, Andy Budina “Scaling in Cloud Environments”
- [2] Frank Leymann “Cloud Computing: The Next Revolution in IT” September 2009
- [3] Kaufman, L.M. “Data Security in the World of Cloud Computing” July 2009
- [4] Zhang Jian-hua “Cloud Computing-based Data Storage and Disaster Recovery”

About the author:

Danko Naydenov
Eurorisk Systems Ltd.
31, General Kiselov Str., 9002 Varna, Bulgaria
E-mail: sky at eurorisksystems dot com