

# A Thunder in the Cloud

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## Summary

Over the last decade, the endless possibilities which are available on the Internet put the spotlight on cloud computing as a concept and it soon spread rapidly throughout the IT society. Many have recognized that this concept is a very fertile ground for the full recognition of some previously known concepts, such as the concept of software reusability, and provides the infrastructure for the development of more secure software solutions. It made companies, and their clients, to feel safer than ever, leading them to one mission – to become a part of the cloud. At the same time, the increasing number of final users caused enormous quality growth of the various services given in the cloud. This kind of evolution, followed by a constant competition between involved contestants, made a stormy surrounding where one leader doesn't have to be a lifetime leader. In this paper we presented the milestones in the evolution of cloud computing concept with special emphasis on the ongoing developments. After presenting the features of this concept we also took note of the contribution and impact on the development of cloud computing one of the current leaders in this field.

## Key words

Cloud computing, Software as a Service, Platform as a Service

## 1. Introduction

The first idea about grouping computers with less impressive characteristics in collaborative group in order to simulate super-computers was born two decades ago. Many acknowledged hardware manufacturers tried and succeed in applying this kind of concept. By setting specific parameters, clustered computers were able to communicate with each other solving the tasks through parallel processing. Therefore, the major task for the software which was serving clustered computers was to find the least occupied processor and forward the task to it.

## Objective

What piece of cake Cloud does the Google get? How many ingredients was originally produced by Google and made cloud as it is today? Are there any historical conditions that made perfect background for developing the Cloud? What are major prerequisite for the Cloud to survive every single review?

## Approach

Answers to all of these questions cannot be separately presented. They are rather composed of parts that mutually interlace. Cloud computing is described through the historical perspective, making the reader to understand what made people to think about this concept positively. Afterwards,

there are some short reviews on development of services that made the Cloud what it is and description of Google's share in conquest of the market.

## 2. Cloud computing

The first idea of the "grid" concept was presented by Ian Foster and Carl Kesselman (Foster, 2002). They wanted to build infrastructure with IT resources that would give the end-users opportunity to use whatever they need, no matter if it is software or hardware, as long as they pay for the quantity that they use. This concept was based on idea of plug-and-play system. The only problem with this proposal was that it didn't have an adequate answer to many requests that were sent by many users. Furthermore, it caused inevitable appearance of bottlenecks in I/O operations. What is more, data exchange and manipulation were done with a certain delay. To sum up, solving problems with data would make the concept live. The only reasonable solution for this problem was to hold data secure and that's the moment when the data centers start their evolution. At that moment, when the users were equipped with the place to store their data, they only had to take care of infrastructure of their own systems. Cloud computing is often mistakenly confused with virtual data centers, because of their similarity. Virtualization represents a way of storing data on one computer physically, but in different operating

systems. This way of using hardware resources is known long ago, but it used to be called pseudo-computers. Nowadays it is called platform virtualization and it represents a way of saving resources of a company. This service is available in the cloud, especially when it comes to dedicated hosting, which can hosts up to 200 virtual operating systems per one host server.

Besides the virtualization and data centers as main resources, the other feature that emphasize the importance of cloud computing concept is the opportunity to use software as a service, platform as a service, infrastructure as a service, monitoring as a service etc.

**3. Software as a service**

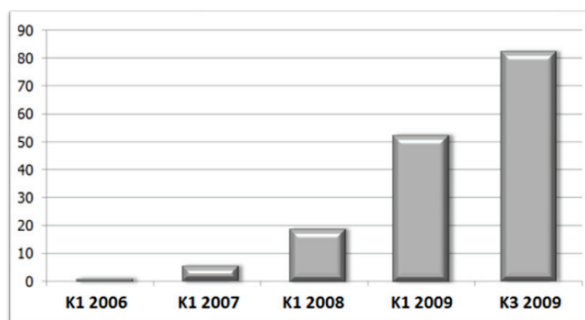
Software as a service (SaaS) is an application developed to support communication among many users. This type of service considers that end-users use software as much as they need, without taking care of license and servers that software uses. The users are paying for what they use and they don't have extra expenditures which are related to staff trainings, paying license, upgrading hardware and other things that go along with reliable software. The company Salesforce.com represents an ideal way of concept usage. Marc Benioff, the founder of this company, developed the concept of delivering applications over a web site online. GoogleApps represents another example of how business can grow if the concept is used in the right manner.

**4. Platform as a Service**

On the other hand, Platform as a service (PaaS) gives a platform where the end-users can develop their own applications based on a given APIs (Application Programming Interfaces). Instead of developing complete applications from the scratch, programmers can use components developed earlier to fulfill impressions of their application. This is a perfect way for a programmer to set his own application in a timely manner, so it could be used by millions of other users over the Internet. For example, if you are a facebook user, you could develop an application based on their cloud, using their API's. What is more, there are already two examples of platform being used successfully like Mafia Wars and Farmville. Another example of such a platform is Google App Engine (Lenk, Klems, Nimis, Tai, & Sandholm, 2009), which, in most cases, represents the perfect way to develop an application that is going to have a heavy load

and process lots of data. Development environment of GAE consists of: dynamically serving server with full support for the standard web technologies, data warehousing with ability for sending queries, sorting data and managing transactions, automatically scaling, load balancing and API for authentication of users and sending emails by using Google account. The Google App Engine PaaS itself was implemented with programming language Python and has a wide usage in developing applications (Rittinghouse & Ransome, 2010).

Amazon S3(Simple Storage Service) is designed for development of constantly growing applications. This service provides collecting the data whenever is needed no matter the location. This way programmers have the opportunity to use the infrastructure which is reliable (Amazon S3 Team, 2008), fast, with low costs and the most important, which is used by Amazon itself. Amazon.com had important role in developing cloud, because it gave his users access to a web service. This approach modernized part of cloud computing when it comes to services. As a result, Amazon had an enormous growth of objects used inside their cloud, which is showed on Figure 1(Vogels, 2009).



**Figure 1** Number of objects (mostly applications) in Amazon S3 over the last 5 years

**5. Features of Cloud computing**

Amongst many possibilities, such as availability of business data, low costs of maintaining software, unlimited access to data, cloud computing doesn't have any barriers to market promotion, because time-to-market is minimized as much as possible (Šereš, Horvat & Horvat, 2010). Furthermore, beta solutions are tested from the moment they are created. The example of one solution that was widely used in beta phase is Gmail.

Some of the major characteristics of cloud's reliability are:

- Multitenancy - resources and expenses are shared among many users, keeping the data available only to the real owners.
- Centralization - centralization of infrastructure and lower expenses of maintenance.
- Peak load - maximum capacity is the highest possible.
- Underutilized - efficiency of systems which doesn't contribute enough considering the resources that they use.
- Dynamical location of resources - no matter which resources are used and where they are positioned, the response is in time manner.
- Performances are secured - supervising of server provider.
- Reliability - increased, because errors are constantly removed and repaired.

Scalability of application is supported by the infrastructure of the cloud. Therefore, safety of the client's data is preserved. On the other hand, cloud requires a lot of resources and fast broadband penetration. This can grow into a vast problem, because cloud computing is unsustainable without fast connections. This is especially stated in USA, which represents the widest market and has one of the slowest connections.

What is more, technical standards needed for cloud computing aren't precisely defined and approved by a public authorities. Therefore, so far, there is no appearance that cloud computing is going to grow. Because of its availability, online observation and testing every minute every day, it is exposed and observed by eyes of the public. This is, probably, the strictest way to evaluate the cloud, usually implying that the cloud is unreliable.

## 6. Google as a part of the cloud

Companies whose primary activity is based upon information technology, represent the greatest names in cloud computing. Those are: Google, Microsoft, Amazon (Velte, Velte & Elsenpeter, 2010), Yahoo, Salesforce.com, IBM and others. Google represents the company that had the greatest influence on development of the cloud concept. This influence was encouraged with innovations that Google brought to constantly changing requirements of demanding Internet users. For example, the youngest one would always want technical support for every new piece of technology is presented on the market. Take for example the situation with the iPad. The first day the iPad appeared on the market, Google already had a software solution for many youngsters and

theirs iPads. It is important to follow trends or prepare to be the abandoned one.

### 6.1. Google App Engine

After a few years of testing the software, by developing their applications, Google decided to give the users an easier way to express themselves. Google gave them the service that could make their programming easier, and their application would certainly do what is required with the resources that are at disposal. Some of the advantages, when users are developing an application with GAE, are:

- Programmers can build, run and test their code in the same environment, meaning the same infrastructure (Goth, 2008). Server is already configured, so the application is instantly running. The programmer's major task is creativity. Hardware resources are not in his charge.
- Problems that come with every day usage of application by many users are removed. For example, increase of the traffic usually means reorganizing of the physical structure of the database. Instead of that, GAE with its automatic replication and control of reading the data have an effect on scalability of the application. Google guarantee that every application developed in GAE environment can serve up to one million users. This feature is enlivened with Google's model of collecting data, which they call Bigtable. It has never been used for developing any application outside the Google.
- Simple integration with the rest of the Google services - reusability is another advantage with developing applications, especially when the applications have the similar components, like email service or authentication. This way GAE makes developing application similar to plug-and-play system, where users can find what they need and use completed solution that is already tested. All of this is provided with great API library that helps with creating features in applications.

Over the last decade, Google Company tried to develop scalable infrastructure for developing web applications. At the beginning, Google had only two services: search and mail. This services, because of their reliability and free of charge usage, helped Google to gain first users. Nowadays, Google is charging some of his services. The next goal is getting users - programmers as their final users, as much as possible.

## 6.2. Google Web Toolkit

GWT simplifies process of developing and compiling web applications in familiar environments to developers, i.e. Java or c# programming languages (Velte et al., 2010), allowing them to upload any version of application as highly optimized JavaScript. Google Health is a real-world example of an application developed with the help of GWT. It represents one of the more advanced services with lots of different functionalities provided to the users. GWT is especially significant from the perspective of developing GUI elements for complex web applications which aspire to have the complete sensation of a modern desktop applications feeling the ease of achieving it.

## 6.3. Google Chromium operating system

Chromium OS represents Google's idea on how the operating systems will look like in the future. It is completely based on cloud services, and in perspective offers all the functionalities found in classic operating systems we know today. It is based on UNIX kernel, whose sole purpose is to start the browser which is in fact the backbone of the whole operating system. The OS currently covers many different services, with the list expanding on a daily manner. The OS targets the netbook segment of the market, as these machines are ideal for running such a low demand operating system. The primary purpose of these operating systems is to provide internet access. Chromium is not the first cloud operating system - there are already a handful of other similar systems, but none of them hitting a significant user base.

## 7. Conclusion

Our research pointed out many hidden possibilities of cloud computing concept where we made emphasis on those which, in ours' opinion, make cloud what it is today.

We concluded that the initiator that caused everyone to reassess the way they do their business was Google. It tremendous impact on cloud shaping reflects in their constantly revealing of new features. What is more, they evaluate everything they place on market letting the final users to test it at the same time. This kind of positioning at the market raised the Google from his competitors and gave the opportunity to become sustainable company in turbulent environment.

Our future work will be based on doing research of use case scenarios for the companies that put their entire business in the cloud and succeed in making it profitable, as well as on cloud computing as green technology.

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