

Analysis on Cloud Computing Database in Cloud Environment – Concept and Adoption Paradigm

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With the development of the Internet's new technical functionalities, new concepts have started to take shape. These concepts have an important role especially in the development of corporate IT. Such a concept is „the Cloud”. Various marketing campaigns have started to focus on the Cloud and began to promote it in different but confusing ways. This campaigns do little, to explain what cloud computing is and why it is becoming increasingly necessary. The lack of understanding in this new technology generates a lack of knowledge in business cloud adoption regarding database and also application. Only by focusing on the business processes and objectives an enterprise can achieve the full benefits of the cloud and mitigate the potential risks. In this article we create our own complete definition of the cloud and we analyze the essential aspects of cloud adoption for a banking financial reporting application.

Keywords: Database, Cloud Computing, SaaS, IaaS, PaaS, Virtualization

1 Introduction

Probably the most revolutionary technology of the last decade developed in the Internet is represented by the Cloud. This technology has started to develop due to the promises of developing a futurist business environment. In this kind of environment each company is supposed to spend the minimal amount of money on resources and gain a lot from the work developed. The promise of Cloud Technology consists also in minimizing the Total Cost of Ownership (TCO) making it right for leaders and CEOs to dream about a modern and futuristic company. The idea that a “successful businesses may soon have no chief executive, no headquarters and no IT infrastructure” (Dr. James Bellini) has started to appear in each leader's mind. These are the directions by which Cloud Computing is leading the future. [3]

In order to be able to understand the necessity of this technology we have to define it first. The cloud concept is spoken, written and used in many other ways very often by different people belonging to diverse fields especially

economic and technological. We can realize that by reading a variety of IT blogs, hearing discussions or taking part at conferences. However, the definitions differ from one another. Why there are so many definitions that support misunderstanding about cloud computing?

In our opinion all the perspectives on Cloud computing depend on the background of each specialist. For Dr. James Bellini as futurologist cloud computing is projecting the image of a company with no chief executive, no headquarters, no database on their own machines and no IT infrastructure. “The most valuable resource of this new king of company it will be represented by its connected eco-system” he says.

The idea that Dr. James Bellini encompasses in his statement defines cloud computing as an evolving paradigm. The idea is also shared by economists who complete it with the economical features. “The Economic Benefit of Cloud Computing” publication defines cloud computing as follows: “*Cloud computing uses the same paradigm of shared needs, costs and shared resources leading to shared savings since duplicate ancillary costs (e.g., facilities, power, a/c, personnel, etc.) are greatly reduced, if not*

completely eliminated. Add to these obvious savings areas the virtual elimination of the capital expense associated with annual software licensing (e.g., initial license purchase, annual maintenance, individual help desk support, etc.) and the user savings become dramatic and easily justified. This is especially true in this era of increasing IT needs coupled with decreasing IT budgets. Cloud computing represents one of the few means of meeting next year's IT requirements with last year's budgetary amounts."[7]

This above definition justifies the economical importance of Cloud Computing and states the major advance in IT and business represented by this technology. Speaking from the global point of view it is based on the major resource provider's economies of scale, such as Google. The quality of services is accompanied by massive cost reductions, often over 50%. Basically a major economic advantage of cloud computing is the fact that "it turns capital expenses into operating expenses (CAPEX to OPEX)". Through this reversing of expense type companies are able to direct their capital to other business investments different from IT.

The Cloud is a solution that provides new ways of using external resources that you can configure according to your needs - servers, storage, applications and services. A great economical advantage is that resources are leased by the Cloud provider on-demand and in variable quantities so that the client only pays what he consumes. In other words, if you do not use the resources, you do not pay it.

The secret is the emerging technology that allows all types of companies to match the technical resources of multinationals. To implement a system within a company needs a lot of resources both material and human. If we're referring to a small business, these investments are limited and any IT

investment affects the investments needed in other business areas. That is why Cloud is an ideal solution for small or medium businesses, providing companies the resources to hire an insignificant cost, so that small companies can match the technology of one of the most advanced technologies in the world, which is available locally. The real advantage is that anyone can use for free or for a small amount of money the best services on the market. Companies of 3 or 3,000 people can use immediately cloud services and the price will be directly proportional to the use of the resource. Cloud solutions spare the costs for servers, software licenses, hosting, collocation, database maintenance, specialized technical personnel, upgrades of all kinds, annual subscriptions, etc.

You just need the final service and you can benefit from the Cloud. We assume that we all have a computer with access to the Internet, so we can instantly be Cloud services users. For example, Gmail now allows storage of 25 GB of emails. A local solution in-house offering lower performance would cost at least 3-4 times more per year.

Another definition, written from an academic perspective is presented in the article "Above the Clouds: A Berkeley View of Cloud Computing" wrote by the researchers of RAD Lab (Reliable Adaptive Distribute System Laboratory) at the University of Berkley. This article points out the most important features of cloud computing: *"Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The datacenter hardware and software is what we will call a Cloud."* [1]

The definition explains the essence of a Cloud and the considered component elements. It refers both to the software and hardware, introducing a new term "Software as a Service" that will be further explained.

In our opinion the above definition is an attempt to create a common perspective on Cloud Computing for all the interested parts. Standardization is very important. The lack of standards in information technology can make a technology trickier to use that is why standardization is a goal in every attempt to define the Cloud.

An effort of standardization for the cloud computing definition of made by The National Institute of Standards and Technology (USA): *“Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models.”* [2].

Despite the fact, that cloud computing is still evolving, NIST definition is accurate regarding the solutions nowadays provided. Cloud is not only the next step in computing development, it is a new perception on business applications and the addressed processes, consisting in the movement of all data and computing power on the Internet.

The Complexity of enterprise systems increases with each new technology implemented. As changes in the business environment occur so appeared the need to implement more efficient enterprise systems consisting in great investments of money and human resources. In most cases within a company there are a lot of enterprise applications developed in multiple technologies and also the related databases that the company is forced to have in operation because of investments made over time.

Because these applications justify their existence only by completing the tasks for which they were implemented without

outstanding performance, every company wants to invest in the latest technology so it can enjoy the economic benefits of the digital economy and increased performance gained through innovation. This is where the Cloud intervenes. Through Cloud adoption, each company can benefit from the functionality of the former application and in the same time the performance of the Cloud.

Considering the above explanations about what cloud computing really is, here comes the definition of this article – taking into consideration the standards, and our practical and theoretical knowledge: *“Cloud Computing represents a technology concerning the application as service and a shared pool of configurable computing resources over the Internet based on on-demand system of providing with minimal effort and provider interaction. It is a way to cut the costs, speed-up deployment of new technology and move responsibilities from managers to the cloud provider”*

This definition contains some of the most important characteristics of cloud computing, and some main features that come with the implementation and deployment of cloud services. It combines different views in forming one in order to be the most simple and useful so it can be used as a definition that most people understand, not only IT professionals.

In order to be able to fully understand the cloud we should forget what we've been taught before about traditional IT when the servers were residing in the same location with the company because the inflexibility of conventional IT is surpassed by the cloud computing service model.

2. Cloud Characteristics

The term "Cloud Computing" most likely derives from the cloud's diagram used to represent the Internet. The concept started when telecommunications companies have made a radical shift from point-to-point connections to VPNs (Virtual Private Network) in 1990. Optimization of the use of resources through more efficient load balancing work has brought them major

savings. The term, Cloud Computing was first used in 1997 at Ramnath Chellappa's lecture, when he defined it as "a computational paradigm where

computational limits will be determined by economic reasons and not technical limitations".

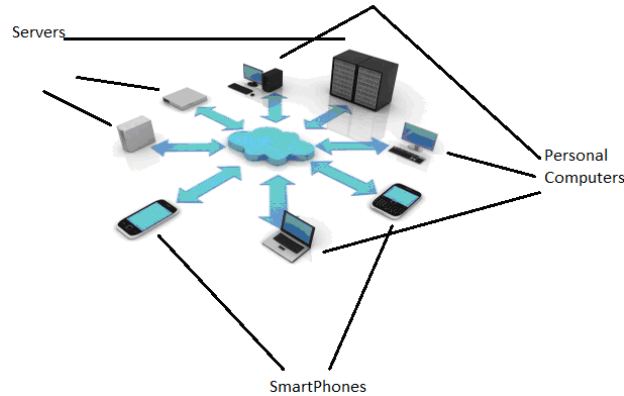


Fig. 1. Proposal for the Graphical Representation of a Cloud

The essence of the Cloud Computing concept is mainly in terms of hardware, with deep consideration to software also, because the processing power is moved on the Internet. Thus some servers placed at addresses unknown by the user bring processing power without physical possession, but only virtually by renting their computation and storage capacity.

The Cloud Computing evolution in the latest years is one of the greatest advances in computing history. Given that this technology will reach its potential in several years, we must have a sound understanding of technology both in terms of consumer and provider.

Cloud Computing is making a lot of advances into all aspects of IT. Databases in the Cloud will experience major architectural changes to take advantage of massive scalability and large amount of data. A product which was released by Oracle especially for database control on the Cloud is Oracle Enterprise Manager 12c. This tool is known for "creating business value from IT by leveraging the built-in management capabilities of the Oracle stack for traditional and cloud environments, allowing customers to achieve unprecedented efficiency gains

while dramatically increasing service levels." [8]

Although many studies are now based on the technology itself, there is a great need for research of the business implications for cloud adoption. In this paper we describe the key issues for understanding the concept of cloud computing.

Cloud service models

The Cloud Computing concept is strictly defined in this article through the services of three models. The **service model** describes an approach whereby the cloud supplier aim to satisfy clients' demands.

Cloud Computing provides functionality to users as a service. This technology changes the angle that we were looking upon software and hardware. The owner of a business should not invest in physical devices. Thus, he must use cloud resources as an alternative solution through pay-as-you-go payment method so he can pay only the resources that he needs. The system recognizes subsequent requests and provides customer the performance they require. Although all cloud services work in the same way they differ in the abstraction level, thus being classified in the following 3 types of services: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). [6]

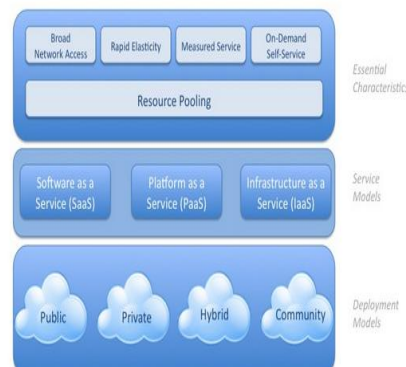


Fig.2. Visual Model of the NIST definition provided on the concept of Cloud Computing [2]

Software as a Service (PaaS)

Software as a Service (SaaS) is a software service model that provides client remote accesses to business functionality such as services offered by cloud. The customer does not purchase software licenses. The infrastructure cost, the maintenance, the rights to use software support are all gathered in a monthly payment or pay as use service. The application can be accessed via the Internet, the most common web browsers that do not require any special hardware or software drivers. It can also be independent of the computer operating system of the machine that uses the cloud services. SaaS is very similar to web applications, spread across three levels: user interface, business logic, and data. On the other hand SaaS applications have special functionalities involving billing and measurement methods based on pay-as-you-go type of payment.

A major advantage of using SaaS applications compared with local machines is the fact that the Cloud applications are not integrated into business applications. Firstly, when you want to change supplier, it's all about how quickly can managers find a SaaS product with more capabilities. There is no need to redesign the application, analyze it in-depth or worry about application maintenance. What you need to do is register on the new provider's website, provide access to employees, set the information for payment and the application is ready to use on the Cloud.

A confusion that is often seen is the misunderstanding created between the concept of SaaS and SOA (Service Oriented Architecture). SOA is a methodology and a framework that defines how services should be delivered to serve certain functionalities. To differentiate the two concepts we can compare SOA with a strategy and SaaS with one of the tactics used to reach targets in the strategic plan. SOA is a term more abstract and cannot be replaced with SaaS or vice versa.

SaaS is a way of delivering applications. The concept of having applications built up in a database supposes to have the freedom to access, without installing any complex software or hardware. The virtual databases maximize the computing resources and it improves the ability to predict resource usage. We suggest that the operations of the database within SaaS to be written in such a way to maximize concurrency and minimize exclusive locking. Databases could be in terms of shared schema for Ad-hoc, Custom Configuration maturity models - shared databases, but also separate databases for scalable, configurable, multi-tenant maturity models.

Platform as a Service (PaaS)

PaaS is a cloud service model working at a lower level of abstraction, compared to SaaS. The functionalities offered to customer are to develop and maintain start-up cloud based applications. The client has no access to infrastructure features such as network configuration, CPU performance, storage or operating systems. Infrastructure is strictly determined and is not in the

client's control. There are still some settings that can be changed and customized according to customer preferences [2]

PaaS is usually described by three groups of services: basic services, infrastructure services, application services. The basic services contain items such as operating systems, storage systems, file and database. All these elements are to be customized by the client. Infrastructure services include authorization, authentication, security settings and settings for online storage. The third group of services, application services refers to functionalities such as measurement and billing. Cloud platforms are very similar to business platforms except that they are made to operate on the Internet.

Although the PaaS model is not as famous and implemented as SaaS, according to Forbes, the year 2012 will be the year that PaaS will be used to its maximum potential. [5].

Our proposition of databases within PaaS concept imply to have open source databases with high performance in replication than native solutions for MySQL and also continuous operations in order to enable zero-down database upgrades. In such a manner the database performance scalability solutions will offer database high availability and incremental performance scaling using commodity databases.

Infrastructure as a Service (IaaS)

IaaS is a cloud service model working at the lowest level of abstraction. Its main features are the provision of processing, storage space, network and other fundamental resources. The hardware infrastructure is outside the control of the client. However he is able to run different software. Sometimes the customer has also the option to change some hardware settings so as to optimize the solution. [2].

Many IaaS providers utilize shared databases. In the case of any application

needed to be virtualized and run in an IaaS environment there is a need of a relational database. Our proposal implies to have such databases in IaaS, as they provide the best solutions experimented until now.

3. Cloud Database Adoption

We already know that Cloud Computing is here to improve the capabilities of a business but how do we know which is the best way to adopt cloud or if the activities in our company are ready to adopt a cloud solution. Taking into account different aspects of our business activity we have to make a thorough assessment before taking the cloud adoption decision. From our work experience we are going to analyze and assess the cloud adoption decision in a banking environment. Banking applications are highly based on databases and the quality of the database administration reflects onto the application itself. Whether you are assembling, managing or developing on a cloud computing platform, you need a cloud compatible database. This paper presents a use-case that shows business problems addressed by using Cloud computing, describing the business considerations that influence an organization to use Cloud computing. It is built on the structured used by The Open Group and enhanced with our own considerations.

This business use-case template is comprised of six main elements:

1. Category – industry, sector, or environment – the category is very important due to the particularities that each of this category has
2. Company Background
3. Business Problem/Description of the situation – the migration to cloud can be suitable only for certain business
4. Actors impacted by this business problem – is very important to know which are the impacted parties when adopting the cloud
5. Key Business Requirements (encompasses quality and/or service-level requirements – where known)

6. Business Risks experienced by this problem – referring to database security, data loss etc, risks [4]

The following table contains a use case for migrating a financial reporting application database in the cloud. The industry/category referred here is represented by the banking environment and specifically by an Eastern European bank with a local representative in Romania. The use case consists in migrating the bank's financial reporting application and database in the cloud.

Category: Banking - Financial Reporting

Company Activity Background

- The bank here in discussion is a local bank forming part of an international group. It needs to report last month's financial situation and provide this information to the mother bank. The bank must address the need to produce different reports with monthly and yearly financial situations to business directors from within the bank. It must also hold a historical database with all the previous reports.

Business Problem/Description

- This company lacks the necessary in-house skills and resources to support the high degree of sensitive data that is required to support its key business processes. Also the financial system already implemented for the financial reporting is growing on data and needs more storage and processing power. The data needs to be aggregated, filtered, and assembled in order to be more useful and generate value for the target audience. Database administration is a problem because of the lack of specialists in the bank.

Actors

- Bank Directorate
- Operational Management
- Business –Controlling- owner of the application
- IT Operations Management

- Database Administrators

Business Requirements

- Need to generate financial reports for directors and to provide on time banking financial situations reporting to the mother bank. Also from the IT Operations Management -ensure that business activities can be carried out during times of additional complexity (reporting period, running of the application such as calculating transfer pricing for whole month data). The database needs to hold accurate data for reporting purposes.

Business Risks

- We have divided this risks in two because they connect and are related: Database risks: Current business operation is exposed to disaster and recovery backup processes either being insufficient or not in place; Database errors are frequent and hard to solve.
- Business risk : Lost information contributes to poor business decisions.
- Loss of business continuity across processes and new ventures; Significant loss of assets or revenue flow; Loss of transparency for stakeholders Inadequate governance due to lack of timely and inefficient reporting.

Modernization

Company Background

- This bank must address modernization of its reporting's processes and applications. However, they do not have the skills in-house to conduct such activities. Existing business services and assets are out-of-date and need modernization. They are using an old database processing system.

Business Problem/Description

- Business needs to have performance in the reporting process and to shorten the reporting time from 15 banking days to less than 10. Business does not have the skills in-house to transition via Cloud facilitation to modernize business processes.

Actors

- Business Procurement Management

- Controlling Department
- Project Management
- Data Center Management
- IT Operations Management
- Database Administrators

Business Requirements

- Need to modernize infrastructure
- Need to modernize applications
- Need to modernize business processes
- Improve employee skills
- Better performance

Business Risks

- Lose of performance
- Losing opportunities due to inability to support new technology
- Impact on existing contracts for support, licensing, and services. Limited licenses for database related products.

Rapid Business Capacity & Scale

- Company Background
- This business needs to scale up its operations rapidly, including increased IT capacity – within a short cycle of days to a few months – to meet specific operating workloads. In particular the bank needs to develop a daily reporting system similar to the monthly one. Developing this system will need a testing environment similar to the production one. The capacity needed will be covered by a lot of purchases translated into EXPENSE.

Business Problem/Description

- There is deficiency of resources and capacity to meet business activity demand to support day and night time peak loads. The company is facing issues such as how to balance compute workloads better; how to optimize costs of operations; and how to follow variable demands of service effectively and



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efficiently at lower cost.

4. Conclusions

As conclusion, we strongly recommend enterprises to adapt cloud services no matter the field they're in. Before that however it is necessary to follow and analyze every issue according to particular business and finally deploy cloud services based on that analysis. In cloud adoption as we stresses above it is very important to know the essential elements of the technology that you want to have in your company and on these core elements analyze and build your own business cloud functionalities.

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