SECURE DATA MIGRATION WITH DYNAMIC GENERATION OF VIRTUAL MACHINE VM IN CLOUD COMPUTING

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Abstract

Innovations are necessary to ride the inevitable tide of change. Most of enterprises are striving to reduce their computing cost through the means of virtualization. This demand of reducing the computing cost has led to the innovation of Cloud Computing. Cloud Computing offers better computing through improved utilization and reduced administration and infrastructure costs. Cloud Computing is the sum of Software as a Service (SaaS) and Utility Computing.

Cloud Computing is still at its infant stage and a very new technology for the enterprises. Therefore, most of the enterprises are not very confident to adopt it. This research paper tackles this issue for enterprises in terms of cost and security. In this paper I discuss the benefits and drawbacks an enterprise can have while they adopt Cloud Computing in terms of Cost and Security.

In the end, concluding that Cloud Computing is better for medium and small sized enterprises as compared to large enterprises in terms of both cost and data security.

Key words: Cloud Computing, SaaS, IaaS, PaaS, Elasticity, Cost, Security

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1. Introduction

The first chapter of this document introduces the topic of cloud computing in general. Together with the introduction, the main and sub-questions are stated and explained. Besides this, the scope of the thesis and the expected result are discussed.

1.1 What is cloud computing

Many possible definitions are to be found for cloud computing. Most of them focus on the technology only (Mell 2011 & Vaquero 2009). Research has been done in order to combine all these different definitions to come up with one (proposed) uniform definition by Vaquero (2009). Cloud computing can best be described as a giant pool which contains hardware, software and other services that can be accessed through the "cloud". All these resources can be accessed whenever necessary. In most cases the provider of the cloud sells his service as pay-per-use. This means that there is high flexibility in the use of these services as extra resources are always available (Strickland 2011).

The definition as described above still leaves a lot of questions about what cloud computing actually is. The giant pool as mentioned earlier refers to the available hardware, software and services as provided by cloud providing organizations. These organizations such as Google and amazon have hardware, software and services running on their own servers at certain fixed locations.

According to the Wikipedia definition of Cloud computing the important three layers are: Applications, Platforms and infrastructure. The application layer (or Software as a service [SaaS]) provides software to potential users, though the users are not able to make any changes in the software. The provider of this software has total control over it. The platform layer (Platform as a service [PaaS]) offers more space for input from the user. The framework and infrastructure are handled by the provider but the user has more input for the applications. IaaS (Infrastructure as a Service) or cloud infrastructure represents the networks and the servers. This layer gives the users the possibility to decide about what happens with the hardware. This Wikipedia definition is supported by papers of Vaquero (2009) and Mell (2009).

Although the previous described distinction has been made for a long time, Armbrust et al (2010) think different. As there are still no clear definitions about what Saas, PaaS and IaaS are, and the line between lower-level infrastructure and high level platforms are not clear, they think they both are more the same than that they are different. On the other side, this thesis works

upon the idea that these layers do provide differences and will thus be described more thoroughly in the literature review.

There is also a distinction made between different clouds according to Armbrust et al (2010), a public cloud, utility computing and private cloud. The public cloud refers to the pay-as you-go setup of a cloud, so you pay for what you need and the time you need it. Utility computing refers to when a service is actually being sold, whereas the private cloud refers to a cloud that is only accessible for the organization where it is positioned and not to the outside public. In the last case it is important that the organization is of such a large form that they can benefit from having cloud computing.

As it becomes clear, there is no uniform definition yet for cloud computing, though they all point into the same direction. It is also made clear that there is definitely a prosperous future for cloud computing (Hayes 2008). He mentions that software is moving towards the cloud in the future whereas it currently comes from the local pc's. It is expected that users and developers will follow this trend. Often people do not know that they are using cloud computing. A simple example is Gmail or Google docs (http://docs.google.com/support/). It is a very good example as this is a free service and is explains perfectly what cloud computing is. Google doc makes it possible for you, and other users, to work online with a word processer with multiple users logged on. The complete document and service are stored online. Any changes made to a document appear real-time to the other users.

The point of this thesis is to show how such systems of cloud computing could help organizations and provide benefits for them. Depending on the sort of company, there are a lot of reasons to think why they need additional hardware or software. The problem will not be purchasing this software, but the high prices are. Cloud computing is relatively much cheaper than when you buy actual software licenses or hardware. Besides this, think of organizations that only need temporarily additional soft- or hard-ware (computing power). It would be a waste of investment to purchase additional hardware and software.

Most growing, starting or expanding (or even large) IT intensive organizations would probably save costs and gain flexibility when using cloud computing (Armbrust et al 2009). Though it is important to research whether this statement is completely true and also to research if the benefits exceed the risks of having cloud computing.

1.2 Research question

The main problem that arises after the introduction is to assess changes that have to be made by organizations. This problem arises when they would use cloud computing in order to expand or start, or maybe only temporarily use the cloud. There is a change in infrastructure as the organizations shift their processing units to another source and location. The technology brings new benefits, but new technology also brings risk. Therefore the main question is:

"What effect can the use of Cloud computing have on IT intensive organizations?"

2 Methodology

This chapter describes the methodology used to do this research. It begins with discussing methodology used in general. Besides this we discuss the research procedure, data analysis techniques and the resources used to conduct this research. Furthermore this chapter describes the thesis outline, which also contains the risk assessment made in this thesis.

2.1 Methodology

This master thesis begins with introducing the topic area and research questions. Equally important is the literature that has been reconciled on beforehand. A literature review forms the basis for this research and provides sources to scientific papers that give insight into cloud computing in an organizational environment. Scientific papers are to be found about the risks and problems that appear with cloud computing. There are not yet many solutions that are linked with cloud computing's problems, there are made only suggestions to solve the issues.

Besides Scientific papers there are also several books published in the area of cloud computing. These books will help to form the basis for the literature review together with the scientific papers. Further additions for this thesis are found on websites, journals and blogs.

The interviews are focussed on organizations that use (Or possibly can use in the future) cloud computing as a customer. The amount of interviews is difficult to estimate on beforehand, but at the end of 3 interviews with (possible) cloud users and a conversation via chat and phone with a cloud provider the results that came out are very similar. This could also be a limitation, because it is hard to generalize based upon 4 sources. However, based upon these interviews I do not expect to find major differences when taking 30 or 40 interviews. The organizations as chosen are based upon their location in the market. So we have a cloud provider, a cloud user, a cloud

user which uses cloud computing also as solution for their customers, and a small ICT organization. If we look at for example the cloud provider Rackspace, we can see from the website that revenues are growing. This shows the growing use and potential of Cloud computing because their core business is Cloud computing. Other organizations such as Microsoft or Amazon are also doing serious marketing in order to increase the use of cloud computing, which shows that it is really a technology than cannot be neglected anymore.

The (sub) research questions are the base for the following chapters. These chapters are shaped with both literature and information gathered from interviews.

Cloud computing is yet in a beginning stage so it is difficult to find a lot of organizations that already implemented cloud computing. Therefore this thesis will be done in a combination of a case study and descriptive study.

After the chapters based on the sub research question, an analysis will show and point out how cloud computing could benefit organizations. The analysis will provide the basis for the answer to the research questions and the conclusion. The analysis of all the combined information will eventually lead to the answers of the sub questions and of the main research question.

The risk assessment is based upon previous research and measures using anchoring. The assessment shows the most important risks with highest impact. The anchoring and assessment is done by me personally. I used the information gathered from the interviews and the literature to do so.

2.2 Thesis outline

This thesis begins with explaining what cloud computing actually is and what applications it makes possible. After the explanation of this phenomenon, the literature study follows. All the cloud computing literature is reviewed and looked at critically. Most important information from these sources is gathered and discussed. In order to obtain new information about cloud computing the next part contains information obtained from different interviews, several interviews contain a financial model. After this we take the literature together with the empirical data and try to describe the most important risks and benefits of cloud computing. The risks are then being assessed according to an adapted model from previous research. In the end we try to model the risks and benefits together for a quick overview for any cloud user.

2.3 Information Sources

The main sources are the IT organizations that are being interviewed and also Cloud computing providers or organizations that are already using it. Other sources are to be found on the internet such as scientific papers and seminars.

The interviews will leave room for organization representatives to give their own input. The interviews contain open questions; closed questions will be avoided as they usually do not provide a lot of data and information.

Papers, seminars, books and internet are used to support the literature review and analysis of the research. Theories such as i.e. Diffusion of innovation are obtained from both books and internet.

2.4 Fieldwork Research Procedure

As the interviewed organizations are very different there is no standard way of doing an interview. All the interviews do tend to be (semi) structured. The questions that are asked in these interviews vary and depend on what sort of organization it is. There are IT organizations which use IT to perform their core activity. They are mainly depended on their IT systems in order to perform their daily routines.

The IT organizations interviewed vary from rather small to multinationals, this is because we then get a good overview of all kinds of organizations. The larger organizations also tend to have a lot of different IT systems.

The questions asked in the interviews leave room for the interviewee to comment themselves about the topic, in the area of the question. This provides additional information

2.5 Data Analysis Technique

For this research there are several general steps than can be distinguished. First of all the thesis starts off with a literature study in the area of cloud computing. It explains all the ins and outs of the thesis topic. Next are the interviews that provide a base for the first analysis. Some small cases can be obtained from these interviews and these are then compared with theory in order to analyze the cases and say something useful about them. From all the interview data together we

can extract a set of models. These models should then apply in general lines to other companies that are willing to use cloud computing from the customer side. From here on we can make a complete data analysis about the whole thesis.
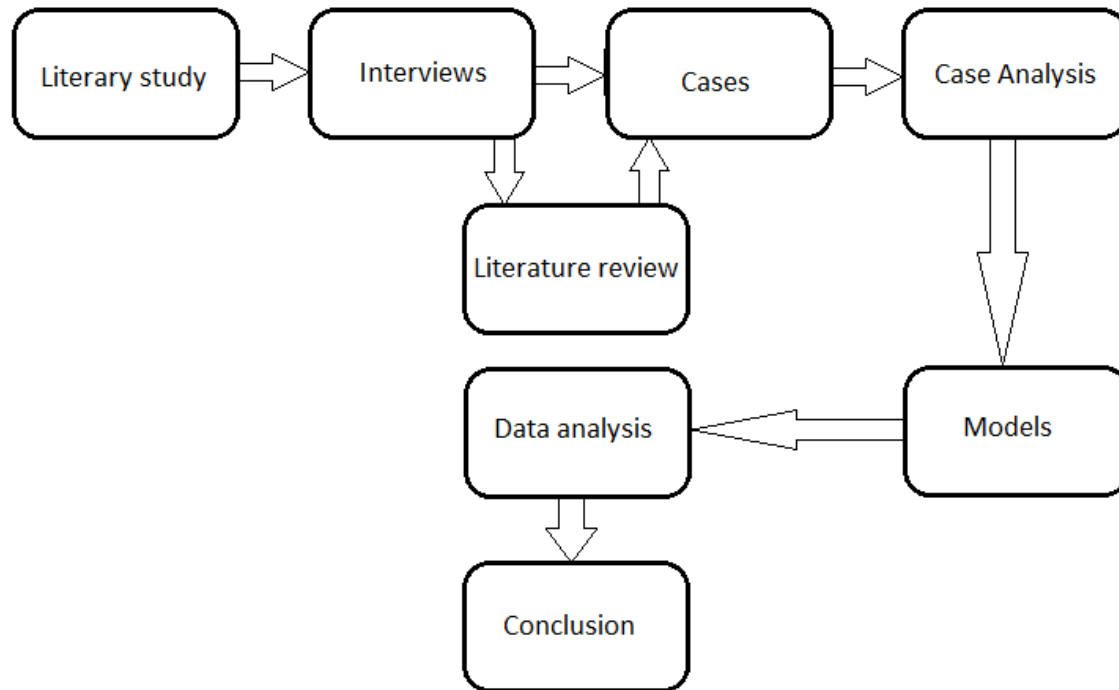

Figure 1: Data analysis technique

At the end we are able to provide the conclusions and thus answer the main research question. The conclusions are based both on sub-questions and the main research question.

2.6 Overview Of Alternative Strategies

This master thesis research is being done by using the methods of qualitative research. Other form of research is quantitative research. This would result in a completely other kind of research than this one. It would be more based on questionnaires or numerical data from certain analysis.

Simulations could be held in order to test the risks of cloud computing, but it would not be as useful as an analysis which extracts data from real life organizations. Simulations would simplify the reality to much in this case. Questionnaires are also out of the question because it

would be meaningless to receive a lot of questionnaires from one organization providing different answers. Interviews are a much better solution for gathering information in this research.

2.7 Expected results

In advance to the complete research there is in general a line of expectation and outcomes. These outcomes will be discussed in relation to the research (sub) question(s). In general the results of using cloud computing are expected to be positive. This is because there are already some organizations providing cloud computing services such as Google and Amazon. Also the technology of cloud computing is already in the phase were innovators start to take a small market share. It is expected that early adaptors will follow in using this technology, Rogers (1962).
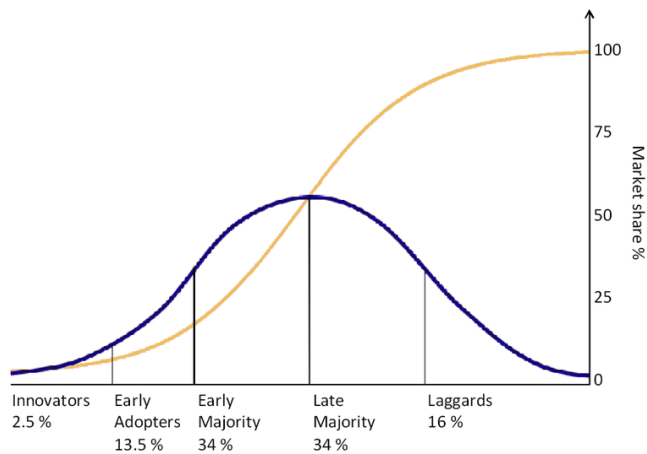
Adaptation to new technologies
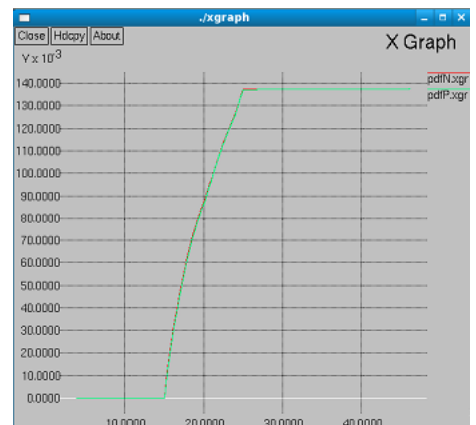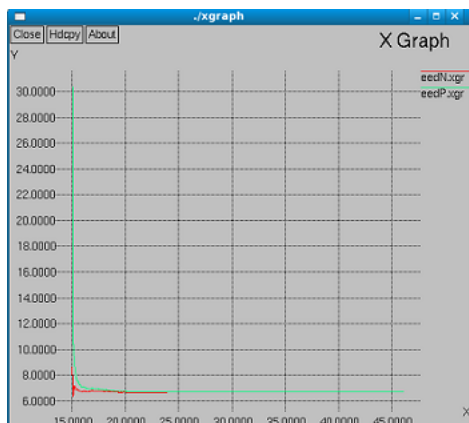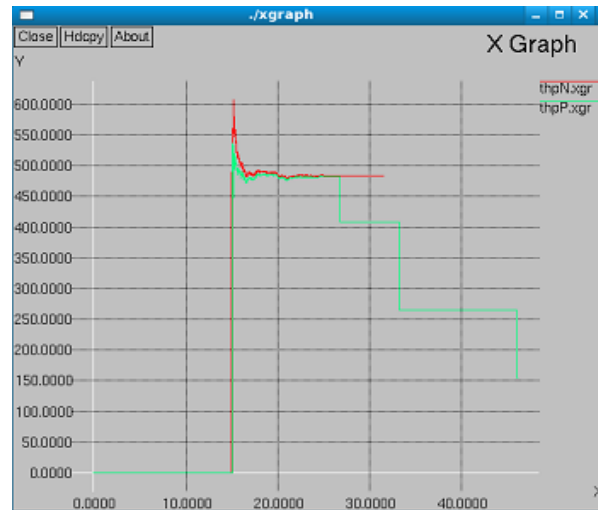
Organizations are expected to benefit from cloud computing as they will gain higher flexibility in using hard and software. This can be when using it for temporarily extra computation power, but also for starting or expanding organizations. They are able to purchase additional services for just a fraction of the price they would have to pay when they want to buy it themselves. Though possible issues with this are that the core business of IT intensive organizations are shifted toward the cloud computing providers and thus also exposed to their risks and issues. The organization gets very dependent on the service the providers give. The organizations are therefore exposed to a risk that cannot be handled directly by themselves but needs to be handled by the provider. The provider must be able to provide a certain amount of security in order to keep the organizations data and processes safe. It is expected that they have security software running in their clouds, protecting data and processes from any hazard. Also the physical location of the cloud has some form of protection.

All together the infrastructure of the modern IT organization as we know it now will change in a more mobile and flexible organization. The IT infrastructure will completely be revised causing this higher form of flexibility. Hard and software will be a service to them instead of having this internally.

3.   LOAD BALANCNG IN CLOUD COMPUTING ENVIRONMENT

In this chapter a general overview about load balancing has been discussed and what is the need to balance load, and what benefits should be attain when the load of a system is balanced [18].

3.1 Introduction of Load balancing

Load balancing in cloud computing provides an efficient solution to various issues residing in cloud computing environment set-up and usage. Load balancing must take into account two major tasks, one is the resource provisioning or resource allocation and other is task scheduling in distributed environment [18]. Efficient provisioning of resources and scheduling of resources as well as tasks will ensure [19]:

a.   Resources are easily available on demand.

b.   Resources are efficiently utilized under condition of high/low load.

c.   Energy is saved in case of low load.

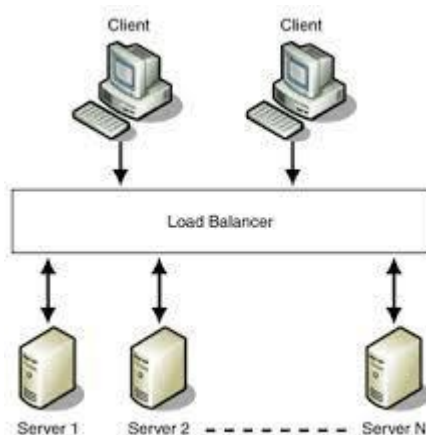d.   Cost of using resources is reduced.

Figure: 2.1 – Simple View of Load Balancer

For measuring the efficiency and effectiveness of Load Balancing algorithms simulation environment are required[13]. During the lifecycle of a Cloud, it allows VMs to be managed by hosts which in turn are managed by datacenters. Cloud provides architecture with four basic entities[23]. These entities allow user to set-up a basic cloud computing environment and

measure the effectiveness of Load Balancing algorithms. A typical Cloud modeled using consists of following four entities [17]i.e.

1.   Datacenters
2.   Hosts
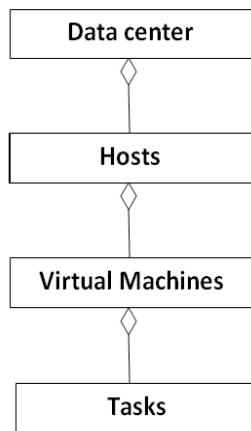3.   Virtual Machines
4.   Application as well as System Software.

Figure 2.2: Class Diagram of Cloud

Datacenters entity has the responsibility of providing Infrastructure level Services to the Cloud Users. They act as a home to several Host Entities or several instances hosts' entities aggregate to form a single Datacenter entity.

Hosts in Cloud are Physical Servers that have pre-configured processing capabilities. Host is responsible for providing Software level service to the Cloud Users. Hosts have their own storage and memory. Processing capabilities of hosts is expressed in MIPS (million instructions per second) [7]. They act as a home to Virtual Machines or several instances of Virtual machine entity aggregate to form a Host entity.

Virtual Machine allows development as well as deployment of custom application service models [8]. They are mapped to a host that matches their critical characteristics like storage, processing, memory, software and availability requirements. Thus, similar instances of Virtual Machine are mapped to same instance of a Host based upon its availability.

Application and System software are executed on Virtual Machine on-demand. Class diagram of Cloud architecture illustrating relationship between the four basic entities is shown in figure 2.2 Thus, the object oriented approach can be used to simulate Cloud Computing environment.

3.2 Types of Load Balancing Algorithms

Depending on who initiated the process, load balancing algorithms can be of three categories as given in :

- **Sender Initiated:** If the load balancing algorithm is initialized by the sender
- **Receiver Initiated:** If the load balancing algorithm is initiated by the receiver
- **Symmetric:** It is the combination of both sender initiated and receiver initiated

Depending on the current state of the system, load balancing algorithms can be divided into 2 categories as given:

- **Static:** It doesn't depend on the current state of the system. Prior knowledge of the system is needed
- **Dynamic:** Decisions on load balancing are based on current state of the system. No prior knowledge is needed. So it is better than static approach.

3.3 Need of Load Balancing in Cloud Computing

In cloud computing load balancing is a mechanism that allocates the excess dynamic local workload uniformly across all the nodes. This is used to attain a high user satisfaction and resource utilization ratio and making sure that no single node is overwhelmed, henceforth improving the overall performance of the processing system. Proper load balancing can support in utilizing the available resources optimally, thus minimizing the resource consumption [8]. It also aids in carry out fail-over, enabling scalability, evading bottlenecks, over-provisioning, reducing response time etc. Hence we get the following benefits when we balance the load of a system. The goals of load balancing are [23]:

- To improve the performance substantially
- To have a backup plan in case the system fails even partially

- To maintain the system stability

- To accommodate future modification in the system

3.4 Metrics of Load Balancing

There are some qualitative metrics that can be improved for better load balancing in cloud computing which are as following [21][22]

- **Throughput:** It is the total number of tasks that have completed execution for a given scale of time. It is required to have high through put for better performance of the system.

- **Associated Overhead:** It describes the amount of overhead during the implementation of the load balancing algorithm. It is a composition of movement of tasks, inter process communication and inter processor. For load balancing technique to work properly, minimum overhead should be there.

- **Fault tolerant:** We can define it as the ability to perform load balancing by the appropriate algorithm without arbitrary link or node failure. Every load balancing algorithm should have good fault tolerance approach.

- **Migration time:** It is the amount of time for a process to be transferred from one system node to another node for execution. For better performance of the system this time should be always less.

- **Response time:** In Distributed system, it is the time taken by a particular load balancing technique to respond. This time should be minimized for better performance.

- **Resource Utilization:** It is the parameter which gives the information within which extant the resource is utilized. For efficient load balancing in system, optimum resource should be utilized.

- **Scalability:** It is the ability of load balancing algorithm for a system with any finite number of processor and machines. This parameter can be improved for better system performance.

- **Performance:** It is the overall efficiency of the system. If all the parameters are improved then the overall system performance can be improved.

4. CONCLUSION AND FUTURE WORK

From the results, it is clear that the replicated agent based load balancing is better than the existing techniques of load balancing in cloud computing. Our simulations clearly show that by using the replicated agent based load balancing dynamically distributes the load over the server which removes the bottlenecks of cloud computing. It   has been assured the data integrity and security of the relevant data must be encrypted by a very strong algorithm very for the data transmission, for security here, we are using Proposed-AES algorithm, this process not only enhances the efficiency in normal routine but also enhance the security more efficiently.

4.1 Summary of the key points

•   By evaluating from the performance metrics **"Packet delivery fraction"** of our simulation is consistent with the previous techniques.

•   **End-to-end delay** of replicated agent based load balancing is less than the previous techniques, lower the value of end to end delay means the better performance.

•   **Throughput** of our simulation is more than the previous techniques. Greater the throughput means more efficient performance.

4.2 Future Scope

There are several improvements that can be implemented on load balancing techniques for making the computing more efficient. Further researches can include more parameters to be improved. The techniques can be changed further and more efficient load balancing schemes can be applied on them. These reviews further leads us idea to further research in cloud computing.

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