Study of the migration of a Document Unit Recommendation Service to Cloud Computing

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Abstract— Cloud Computing is a major current trend to distribute processing and data virtually on configurable execution environments. The development and deployment of software for the Cloud proposes a new scientific challenge in terms of expression and consideration of variability. Indeed, cloud computing is based on principles of heterogeneity and elasticity, which allows many choices of configuration and sizing. Then the migration of existing applications remains the main challenge to be taken into account. Indeed, there are several types of migration depending on the three services offered by the Cloud. In this article we conduct a study on the migration of applications to the cloud in general and specifically the migration of IAAS to the PaaS (Platform as a Service) service of Cloud Computing. The migration of existing systems to the PaaS model has several advantages, but also poses new challenges, particularly with regard to the restrictions imposed by the service provider. In addition, factors such as time, training and extensive re-engineering have been taken into account making the migration process time consuming and error prone. Although there are several techniques for partial or full migration of legacy applications to the cloud, only a few of them solve these constraints. Our work mainly consists of firstly to clearly elucidate the notions of Cloud, "Information Access Assistance Service" (IAAS) and then to study the existing migration strategies in order to propose the most ideal one for the migration from IAAS to PaaS..

Index Terms—Application's migrations, Big Data, Cloud computing, Data migration, IAAS, Recommendation system.

1 Introduction

The Cloud (or cloud computing) is a technological revolution that allows to deposit data (documents, photos, music...) on remote servers and to use online applications. These data and applications were expected to be installed on the user's computer or the cost of management and maintenance was under the responsibility of the company itself. The cloud has therefore beneficial advantages for its users, since it allows to reduce considerably the expenses of the company. Thus, at present, the Cloud migration is a prerogative for the information system that are not cloud native.

Indeed, for the migration of an application to the cloud, it is important to take into account three important factors that are the business objectives, the application capabilities and the costs of the migration; in order to better succeed in the migration. Let's also note that there are different strategies (the most known are six) for different application migration objectives.

Throughout this work we have explored the possibilities of migrating an application to the cloud. To put our money where our mouth is we experimented with the "Information Access Assistance Service" (IAAS) which is a recommendation system designed for document search assistance; experimented in the online library called PMB. Defining a suitable open model for IAAS [4] in the cloud would be a plus as IAAS has been used locally in the library units to make recommendations.

So our work in this paper will mainly contribute to propose possible paths for an application migration on the cloud, presenting the different advantages and disadvantages existing. Thereafter make appropriate choices for the case of IAAS migration.

2 Cloud migration problems and approaches

2.1 Cloud service model

In the literature, there are multiple definitions of Cloud Computing. One of them presents it as "what consists in deporting on remote servers storage and computer processing traditionally located on local servers or on the user's workstation. It consists in offering computer services in the form of on-demand services, accessible from anywhere, anytime and by anyone, thanks to an identification system, via a PC and an

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Internet connection." [3], [22], [24], [25], [26], [27]. The characteristics of the cloud and the cloud service are also described. According to the literature, the cloud has three service models with different roles namely:

- SaaS: Software delivery.
- IaaS: Provides physical infrastructure.
- PaaS: Provides a development environment.

2.2 . Comparison of cloud types

From the results of the above table we can see that the private cloud has exactly the same characteristics as a cloudless system. This means that this type of cloud has more security and offers cloud related benefits. So we choose the private cloud for the implementation of our IAAS [4] system

	Physical Location	Physical Isolation	Operations Control
System Without Cloud	On site	Yes	Company
Private Cloud	On site	Yes	Company
Private Cloud Offsite	Offsite	Yes	Shared
Community Cloud	Offsite	No	Shared
Public Cloud	Offsite	No	Vendor
Hybrid Cloud	Combinaison	Combinaison	Shared

Fig 1 : Comparison by cloud type [5]

2.3 Advantages and disadvantages of migration

a. Advantages and disadvantages of migrating to the cloud
According to the literature [3], [22], [24], the following advantages and disadvantages can be found:,

Benefits
As advantages that can motivate the migration of an information system in the cloud, we can note that it allows :

- Reduce operational costs while increasing IT efficiency.
- To solve the problem of lack of resources and storage capacity.
- Expand your business geographically without the need for infrastructure.
- Create a large-scale distributed development team.

b. Disadvantages of cloud migration
The disadvantages that can be faced when migrating an information system to the cloud are not to be neglected either; these are among others

- Loss of transparency and control when debugging performance issues because the hardware is controlled by another person.
- Impossible to maintain the application in the cloud
- If the application is proprietary the legality will not allow to deploy it on the cloud.
- The architecture of the particular application may not completely follow the cloud architectures

In this section, we discuss the security requirements to be considered before migrating an information system to the cloud. According to [5], whether cloud-based or not, an IT environment must meet six requirements to be considered secure. These requirements are not mutually exclusive. For example, the protection of personally identifiable information is a matter of privacy management and legal obligation. It is also a potential source of risk and exposure. However, careful consideration of each of these six requirements as illustrated in the figure below provides different perspectives that may assist us in our system migration.

2.4 Security issues in the cloud

In this section, we discuss the security requirements to be considered before migrating an information system to the cloud. According to [5], whether cloud-based or not, an IT environment must meet six requirements to be considered se-cure. These requirements are not mutually exclusive. For example, the protection of personally identifiable infor-mation is a matter of privacy management and legal obliga-tion. It is also a potential source of risk and exposure. How-ever, careful consideration of each of these six requirements as illustrated in the figure below provides different perspec-tives that may assist us in our system migration.

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Fig 2 : The six security requirements [5]

2.5 Cloud migration strategies

There are mainly six application migration strategies of which the three most used strategies are: Rehost, Replatform, and Refactor. The complexity of migrating existing applications varies depending on the architecture and licensing agreements of the systems.
In the following we will explain the six (6) migration strategies known as "6Rs" proposed by Gartner [28].

- Rehosting (lift and shift)

Rehosting also known as "basculement" means re-hosting. The first strategy for migrating applications to the cloud, the technique known as "lift and shift" is also the simplest and fastest. It involves moving applications from legacy datacenters directly into the cloud, without making any other changes. The advantage of this method is that it requires very little effort, since the application is not modified at all.
However, the success rate of these migrations is average, and the benefits of the cloud are not particularly taken advantage of. In practice, lift and shift can also generate problems related to differences in hypervisors or basic machine configurations.

- Replatforming (data switching)

Some applications cannot be migrated to the cloud, because they run on systems not available in the cloud (OS version, server type, etc.). In order for the application to work in the cloud, we will therefore change its platform. There is no other change on the application other than its OS layer.
The replatforming strategy has more advantages in the following cases:
-Organizations that are confident that minor changes will not affect the operation of the application
-Companies looking to leverage more benefits of the cloud than just moving the application to the cloud.
If the on-premises infrastructure is complex and hinders scalability and performance, replatform is a good solution.

- Refactoring (Re-architecting or Cloudification)

This is about doing a redesign or reorganization of the product. This strategy of migrating applications to the cloud is also the most interesting. The application cloudification indeed makes it possible to make the most of the advantages of the cloud. It consists of completely transforming an application in order to adapt it to cloud architectures. The application is redesigned: auto-scaling, loadbalancing, self-healing... . An application originally designed for a historical datacenter can thus become "cloud ready".
On the other hand, it is a much longer process than the previous ones. If a "lift and shift" migration can be counted in hours (but with a risk of failure), replatforming can be counted in days, and the cloudification of applications can take several weeks depending on the application. However, if you want to migrate several applications of the same type in this way, once the first application has been migrated, the process is easier for the following ones.
This strategy is mainly used in the following cases:
-When there is a strong business need to add functionality and performance to the application and this is not possible within the existing application.
-When code redesign is required to take full advantage of cloud capability.
-When an organization or individual is looking to increase agility or improve business continuity, the factorial strategy is a better solution.
When an organization is ready to move to a service-oriented architecture (SOA), it can use this approach.

- Repurchasing

This strategy allows to switch to a different product. Repurchasing is most often done to move to a SaaS platform. For example, moving a CRM (Customer Relationship Management) to Salesforce.com, an HR system to Workday, a CMS (Content Management System) to Drupal, etc.

- Withdraw (withdrawal)

It's all about removal, getting rid of unnecessary things. Once the inventory of the entire environment is done, it is possible to search each functional area to determine which one is running each application. Approximately 10% of a company's IT portfolio is no longer useful and can be deactivated. This savings can improve the business case, focus the teams' attention and work on the applications that are being used, and reduce the environment that needs to be secured.

- Retain (Retention)

This is retention, because usually either the application is reorganized or it is not migrated (temporarily). The customer may have amortization difficulties, may not be willing to favor

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a recently updated application, or may simply be reluctant to migrate some of them. Migration should be limited to what is truly useful to the business, and as the bulk of a portfolio is moved from traditional infrastructure to the cloud, there is unlikely to be much to keep. All of these strategies for migrating applications to the cloud, and especially cloudification, are good steps in learning how to leverage the cloud and understand application transformation, but for companies that want to do a mass migration of their applications it is advisable to adopt a phased study.

3 THE LACK OF RESPONSE TO THE SOLUTIONS PROPOSED FOR MIGRATION TO THE CLOUD

We will present in the following the different existing Cloud solutions, their operating modes, their advantages and disadvantages. [3] has made an assessment of the proposed solutions and found them to be unsatisfactory.
Like all solutions, there are two categories of private Cloud Computing solutions, the proprietary solutions and the free solutions. Free solutions

a. . Proprietary solutions

There is a multitude of proprietary software offers to install its own private cloud. We have chosen in the context of our study to explain two of them.

- **Office 365**

As the name suggests, this solution is owned by Microsoft and allows you to create a private cloud for your company. It is ideal for companies with at least 25 employees. According to its presentation sheet, it has several features. Among other things, it allows you to:

-Share files and documents with team members;

-To have a storage space of 25 GB per user;

-Be compatible with Word, OneNote, Excel and PowerPoint files;

-Access, view and edit your documents in a web browser;

-Add and remove users in minutes.

It is possible to get this software from 3,57 euro/user/month.

- **Vmware vCloud**

Developed by the company VMware, one of the world leaders in the field of virtualization, this software is also used to create its own private cloud. It gives the possibility to create virtual machines according to the needs of the users. According to its data sheet, it allows to :

-Create virtual machines in a few clicks, simply transform physical servers into virtual servers.

-Increase private cloud resources with a few clicks and no downtime.

-Benefit from a high availability and fully redundant infrastructure.

-Consolidate servers, automate deployments, and dramatically reduce IT budgets.

b. Open source solutions

As in all areas of computing these days, Cloud Computing is no exception to the rule of free software. In front of paying and proprietary solutions, there are free and open source solutions. These software are developed in community, and are regularly updated. They can be modified at will according to the use you want to make of them. Here is a non complete list of some free software to create a private cloud.

- **OpenStack**

OpenStack is an open source software that enables the construction of private and public clouds. OpenStack is also a community and a project in addition to software that aims to help organizations implement a virtual server and storage system.

OpenStack is composed of a series of open source software and projects that are maintained by the community including: OpenStack Compute (named Nova), OpenStack Object Storage (named Swift), and OpenStack Image Service (named Glance).

It is installed on a free operating system such as Ubuntu or Debian and is configured entirely from the command line. It is a robust system that has been proven to work well by professionals in the field. Its main drawback is that it is quite difficult to install and would work better with DELL equipment.

It is true that small utilities have been developed to improve the installation, such as Crowbar, but it remains quite tedious.

- **Owncloud**

OwnCloud is a free software that allows you to create your own private cloud, i.e. to access your data anywhere, from a simple browser or from different operating systems thanks to dedicated applications and, more interestingly, to synchronize them. The main interest of OwnCloud is that you remain the owner of your data.

Recently released in version 4.5 Beta, Owncloud offers a solution that anyone can install on their own server. Thus, the solution is aimed at individuals as well as companies, even if the latter can benefit from additional functions in the version dedicated to them.

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In terms of features, Owncloud offers:

-File storage, synchronization with different devices (iOS, Android) ;

-Data sharing ;

-Encryption and security of sent data;

-Access to files via a browser, which does not require the installation of the Owncloud client;

Allows to find several old versions of a modified document (versioning);

-APIs available for the creation of additional functions, -Customization of the graphic environment ;

-Migration, data back up ;

-Access to an application store.

Owncloud is installed on a regular PHP server. It uses the WebDAV remote file management protocol, which does not need to be installed on a web server to be used since it is already included in Owncloud. The advantage of this open source solution is also that a synchronization client is available on Windows, Mac and Linux platforms. Its simplicity of use, its open source nature, its well documented documentation, its total independence from hardware layers, makes Owncloud a good candidate for setting up a private Cloud Computing.

- **CloudStack**

Cloudstack is a free software from the apache foundation. It allows the creation of private and public Cloud Computing. Despite its recent release, it enjoys a popularity among professionals in the sector. The advantage of this software is that it can be easily integrated into an existing architecture. It is compatible with different hardware layers. Its advantages are as follows:
-It supports a large number of hypervisors;
-It has a graphical interface ;
-It is expandable;
-It has proven itself.

- **Encalyptus**

Its name refers to the acronym "Elastic Utility Computing Architecture for Linking Your Programs To Useful Systems". Eucalyptus is a set of tools available under BSD license, resulting from a research project of the University of California from 2007, this open source Cloud platform is integrated (in 2009) in Ubuntu Server and Debian. Written in C, Java and Python, it allows to create private, public or hybrid Cloud Iaas (Infrastructure as a service), supports Linux virtual machines as well as Xen, KVM and VMware hypervisors. It is compatible with Amazon's EC2 [19][20].
Eucalyptus is available in two (02) versions, a free Open Source version and a paid Enterprise version. Regarding the installation of this platform, different solutions related to operating systems are proposed such as Windows distributions are able to support Eucalyptus but only with the Enterprise version, paying [18].
Eucalyptus was developed to support high performance computing (HPC). It can be deployed on all major Linux distributions, including Ubuntu, RHEL /CentOS, OpenSUSE, and Debian [18].

4 State of the art on cloud migration problem solving attempts

In this part, we review the research work related to the search for a good migration strategy on the cloud.

Kella Abdelaziz [1] made a comparative study to determine the best migration strategy by comparing the works of [6], [7], [8], [9], [10], [11], [12] and [13]. He used as criteria of comparison the advantages of these approaches, the parameters and resources considered, and the repercussions on the migrated system and on the users. The compared works "seek either to improve the standard migration process or to optimize energy consumption and/or quality of service. He concluded that none of these approaches were totally appropriate for him and he proposed his own approaches [1], [13].

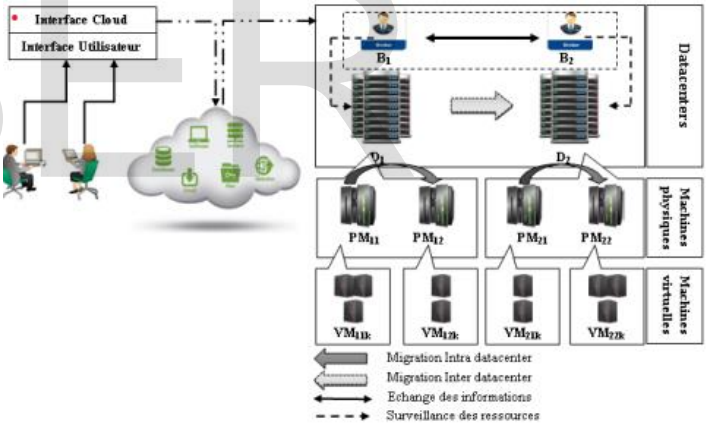

Fig 3 Architecture for the migration strategy of [1].

Data migration.

Various studies have been conducted in this area of data migration. The major concern has been how to maintain the acidity of the databases that will be migrated to the cloud? Matallah has researched and proposed a model for storing and accessing data in the cloud and in big data [2]. This concern has also been addressed by the works of [14], [15], [16], [17] [18] and [19]. The work of [2] then allowed to study local, distributed, shared and parallel file systems. After highlighting the limits of existing proposals, [23] proposes file read/write models and [2] proposes a hybrid migration solution built around Hadoop and MaReduce technology [21], [31], [32], [33].

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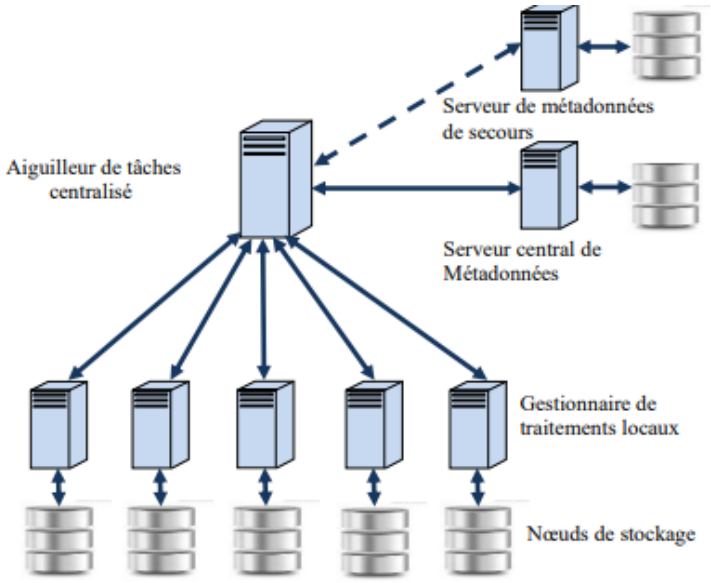

Fig 4 Structure of a hybrid cloud storage model[2]

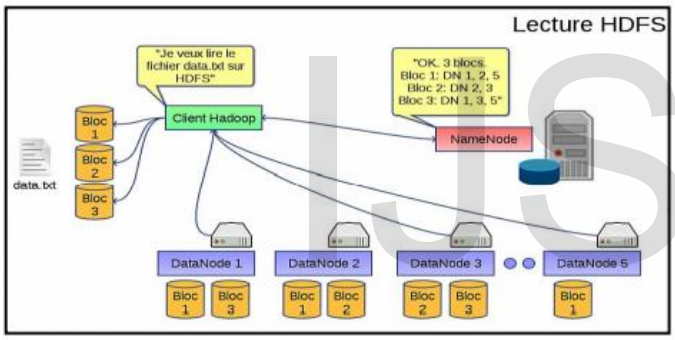

Fig 5: Reading process in a handoop file system (HDFS)[23]

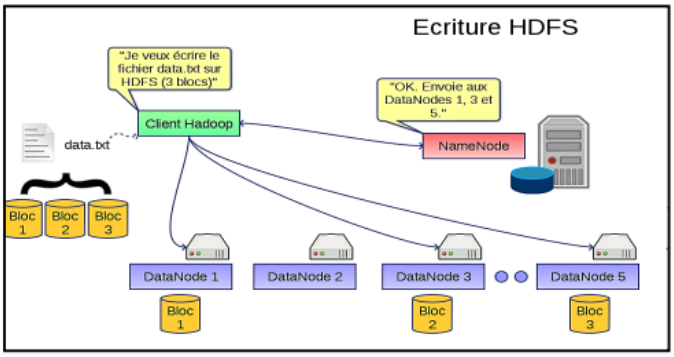

Fig 6 : Writing process in a handoop file system (HDFS)[23]

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Reading process according to [23]

- Step 1: The client tells the NameNode that it wants to read the data.txt file.
- Step 2: The NameNode will send the file size (number of blocks) and the different DataNodes hosting the n blocks.
- Step 3: The client tries to retrieve the blocks from the file at one of the DataNodes.
- Step 4: In case of error/non-response of one of the DataNodes, it moves to the next one in the list provided by the NameNode.

Writing process according to [23]

- Step 1: Let's say we want to store the data.txt file on HDFS: We will use the main Hadoop management command: Hadoop, with the fs option
- Step 2: The program will divide the file into 64 KB blocks (or other, depending on the configuration) - let's assume we have 3 blocks here.
- Step 3: The NameNode tells it which DataNodes are available.
- Step 4: The client directly requests the DataNode concerned to store the block.
- Step 5: The DataNodes will take care - by informing the NameNode - of replicating the data between them to avoid data loss.
- Step 6: The cycle repeats for the next block.

La mise en oeuvre réussi d'une solution de migration passe par une rigeur méthodologique. Cela est démontré par Nina Anggrainia dans [29]. S'inspirant des travaux de [30], elle propose une demarche sûre pésentée dans le figure 6.

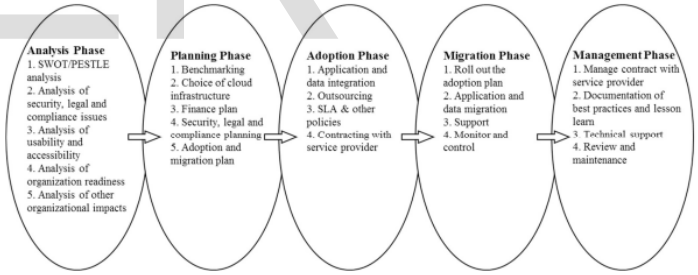

Fig 7 ROCCA Implementation Model [29]

5 STRATEGIC DIRECTIONS ON IAAS [4] MIGRATION

5.1 Features of IAAS [4]

The successful implementation of a migration solution requires methodological rigor. This is demonstrated by Nina Anggrainia in [29]. Inspired by the work of [30], she proposes a safe approach presented in figure 7.

5.2 Application of the solution on IAAS

For IAAS [4] migration we conducted a study to make appropriate choices on: Cloud service model, cloud type, migration strategy and cloud solution.
Based on the study conducted in the state of the art on migration strategies and the above diagram we choose replatform-

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ing as the best migration strategy. Since the solution to be chosen should be mainly based on the following criteria:

- **Robust;**
- **Easy to use;**
- **Under free license;**
- **Expandable**

The solution that best meets all these criteria is: OpenStack. We recommend the implementation of a solution based on Handoop and MapReduce to reduce the complexity of the implementation of the recommendations of the document units.

6 Conclusion and Outlook

We therefore conducted a study on the most appropriate cloud computing migration approaches. We examined the different possible strategies for a good migration of an information system. This study allowed us to make choices on the strategies discussed in this paper, the type of cloud and the ideal cloud solution for IAAS migration. The strategy we have chosen is Refactoring because it really allows to benefit from all the advantages of cloud computing.

Therefore we installed IAAS in a private cloud from the OpenStack environment which presents more security. The OpenStack solution was proposed as it is the most used and considered the most secure in its implementation with good features. We have subsequently given some guidelines for the installation of the openStack solution. But we can retain that the choice of the strategy to get the maximum benefits will depend largely on the objective sought for the migration. In the following we will continue with the configuration of IAAS in the OpenStack solution

As perspectives we plan to evaluate the migration and operation of IAAS on OpenStack and then to define the opportunities of IAAS on the Cloud with the Opestack solution.

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