GENERAL INTRODUCTION

Faced with the ever-increasing costs of setting up and maintaining in-training systems, companies are increasingly outsourcing their IT services to specialized companies such as cloud providers. The main interest of this strategy for companies lies in the fact that they only pay for the services actually consumed.

Cloud Computing is now the flagship topic in the field of information and communication systems. After virtualization, it seems to be the revelation that will allow companies to be more efficient and manage the cost of information systems more easily. But following this shattering entry, we can still ask ourselves how to secure and make information available in a cloud computing system? That's why this engineering thesis is interested in this very new field, at least for us.

The term Cloud Computing, or cloud computing, is a new computing model that consists of providing computer services as on-demand services, accessible from anywhere, anytime and by anyone. This new technology allows companies to outsource the storage of their data and provide them with additional computing power for processing large amounts of information.

The objective of this project is to ensure a more flexible, flexible, available and secure operation of the information system in accordance with business needs at all times. And to deepen and experiment with our knowledge of Cloud Computing and its security aspects, then to take a state of the art approach, in order to choose the best solution available at the moment, to deploy it and evaluate it. To do this, we deployed a private infrastructure cloud as a service.

Thus, this manuscript is structured around four chapters:

- The first chapter we present the data management in a company, study the existing system and then highlight the problem;
- The second chapter gives some definitions and generalities about the Cloud, its security aspects, the management of a Cloud Computing project, the description of the different existing solutions, the presentation of the solution and finally;
- The third chapter shows the specifications, the functional and technical specifications and the various diagrams;
- The fourth chapter details the different phases of implementation, deployment testing and evaluation of the solution.

DEVELOPMENT

We will discuss here how to synthesize the elements developed in our brief.

0.1 State of the art.

To better understand our subject of study, some prerequisites are essential. It is therefore a question here of placing us in the context of the study, namely Cloud Computing and all the concepts that revolve around it.

0.1.1 Cloud Computing Overview

So Cloud Computing is a concept that consists in deporting to remote servers computer storage and processing traditionally located on local servers or on the user's workstation. It consists in offering IT services as an on-demand service, accessible from anywhere, anytime and by anyone. Cloud Computing consists of three parts, namely:

- **Virtualization:** It is defined as all the hardware and/or software techniques that allow several operating systems (virtual machines (VMs), or guest OSs) to run on a single machine, while server virtualization allows greater modularity in load balancing and server reconfiguration in the event of a temporary evolution or failure.
- **The Datacenter: It is** a physical site on which equipment constituting the company's information system is located. It can be internal and/or external to the end-

company, whether or not it is operated with the support of the providers. It generally includes environmental control (air conditioning, fire prevention system, etc.), emergency and redundant power supply, as well as high physical security.

- **The Collaborative Platform:** It is a virtual workspace. It is a site that centralizes all the tools related to the management of a project and makes them available to the actors. Its objective is to facilitate and optimize communication between individuals in the workplace.

0.1.2 Service models and selection criteria

0.1.2.1 Service models

- **IaaS (Infrastructure as a Service):** Infrastructure as a Service is the provision by the cloud provider of an infrastructure with sufficient computing capacity, servers, storage and bandwidth. The advantage of this model for the client is that it allows him not to worry about purchasing and managing materials.

- **PaaS (Platform as a Service):** The Platform as a Service provided by the cloud provider of a platform already configured to allow the customer to deploy the desired business applications. The advantage is that the customer does not have to worry about hardware, maintenance or updating of virtual servers.

- **SaaS (Software as a Service):** The Application as a Service: The cloud provider provides an application that is accessible to the customer via the Internet network. Thus, the deployment, maintenance, proper operation or data management of the application are the responsibility of the supplier.

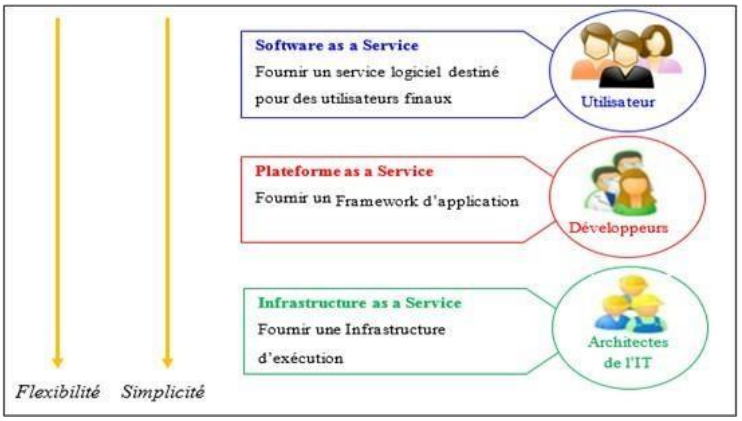

FIGURE 0.1 - The different levels of Cloud Computing services.

0.1.2.2 The selection criteria

To simplify the process, we can classify the features and functionalities for choosing a decision analysis tool into three (03) categories:

- **Essential Features: There** must be no doubt that you belong to this category. In other words, if the product does not have the characteristic in question, it is rejected outright.
- **Useful Features:** Although these features are not essential, they often make the difference when choosing a product.
- **Unnecessary Features:** These features are simply left to the user's discretion, but they donot really weigh heavily in the balance.

0.2 Study and implementation of the solution

0.2.1 Project study

It was essential before starting any activity to plan the project. This is how we were able to draw up the following schedule:

Table 0.1 - Project Phase

Approach	Branches	Duration
State of the Cloud Computing Art	Functional branch	6 days
Comparative study and choice of solution	Functional branch	14 days
Analysis and specification of needs	Functional branch	30 days
Technical specifications	Technical branch	24 days
Designing	Realization branch	17 days
Implementation	Realization branch	25 days
Tests and tests	Realization branch	18 days

Here we represent the tasks in a Gantt chart

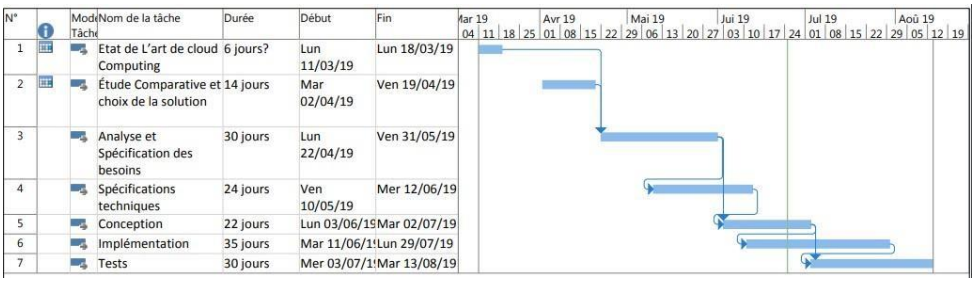

FIGURE 0.2 - Cloud Computing Project Planning (source: Our Care)

0.2.1.1 Preliminary study and specification of needs

Our cloud is essentially aimed at two types of users: the administrator and project members. This part is used to detail all the functionalities that the cloud, through its portal, must offer to users. Indeed, the system to be implemented must meet the following functional needs:

- **Image management:**
- **Instance management :**
- **Volume management**
- **Flavor management**
- **Project Management**
- **User management**
- **Security and access management**

The system to be implemented must also meet the following non-functional requirements:

- **Simplicity of an on-demand service:**
- **Extreme flexibility**
- **Light access**
- **Safety and security**
- **Liveliness**

0.2.1.2 General Use Case Diagram

In this diagram, we present all use cases concerning the administrator

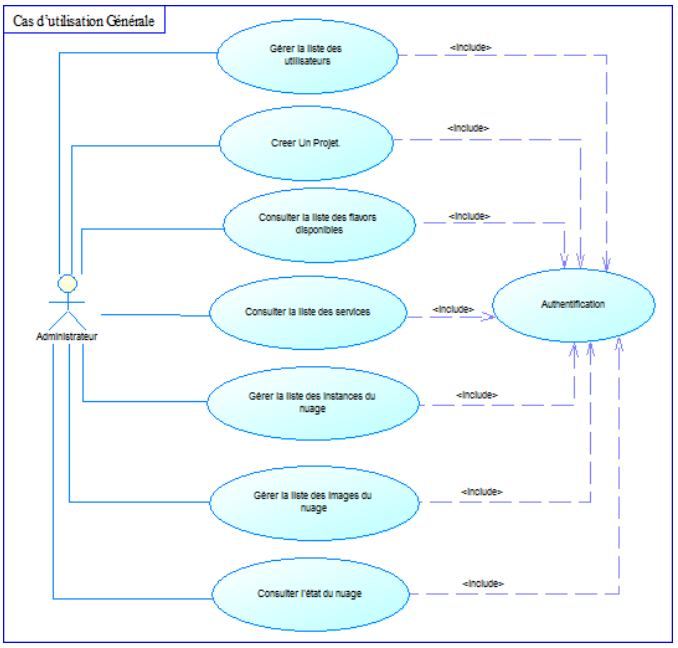

FIGURE 0.3 - General Use Case Diagram

0.2.1.3 Global sequence diagrams

The figure below shows the global system diagram of some use cases: the scenarios of some cases.

FIGURE 0.4 - Global Sequence Diagram

0.2.2 Implementation of the Cloud Computing solution

0.2.2.1 The Components

OpenStack has a modular architecture that includes many components. Here is the list of components integrated into OpenStack.

- **Compute:** Nova (application)
- **Object Storage:** Swift (object storage)
- **Image Service:** Glance (image service)
- **Dashboard:** Horizon (Web interface for configuration and management)
- **Identity:** Keystone (identity management)
- **Network:** Neutron (formerly Quantum) (on-demand network management)
- **Storage:** Cinder (persistent disk service for virtual machines)

0.2.2.2 System deployment diagram

The figure below illustrates the system deployment diagram.

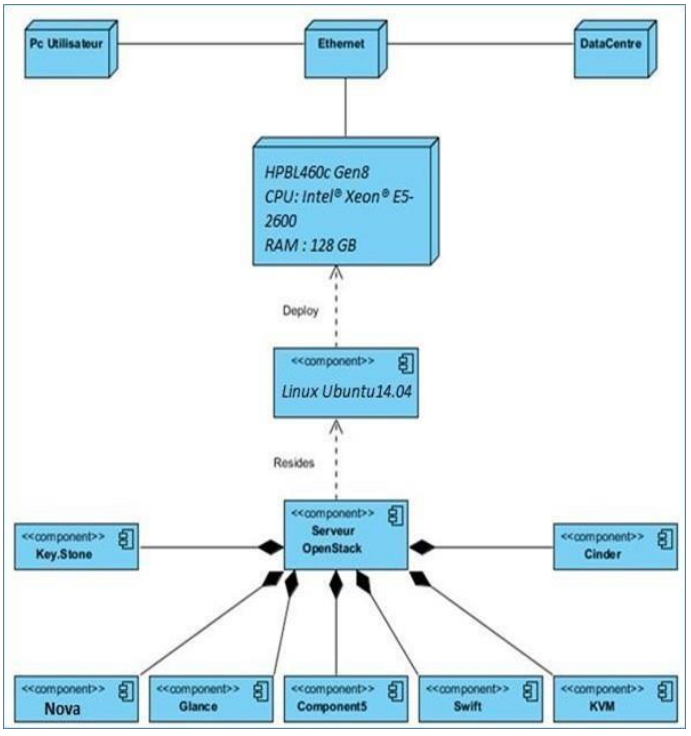

FIGURE 0.5 - System Deployment Diagram

0.2.2.3 System authentication page - OpenStack

The first one performed by the administrator who connects to the horizon is authentication.

FIGURE 0.6 - System Authentication Page - OpenStack

0.2.2.4 Overview of the OpenStack system

Once logged in, depending on access privileges, the user is allowed to access specific projects. The following is a preview page for a project belonging to the **admin** user.

FIGURE 0.7 - System Overview - OpenStack

GENERAL CONCLUSION

During our work, we conducted a study on the availability and security of data in a cloud computing system. We started by giving the basic definitions necessary for understanding the Cloud, its architecture and its different types (private, public, hybrid) and services (IaaS, PaaS, SaaS), then we presented and detailed the different open source solutions allowing to set up a Cloud by making a comparative study between them. This allowed us to have a precise and complete idea of the available cloud solutions and above all to choose the one that best suits us. In order to set up our Cloud under OpenStack and then secure the data and make it available, we started by using UML formalism by drawing use case and sequence diagrams, this helped us to define user needs. We then had OpenStack implemented, which required hardware and software prerequisites.

The implementation of our solution was done under the Ubuntu server 18.04 operating system which was installed on a virtual machine. This project being very ambitious, we quickly encountered many problems, whether due to cloud solutions or their implementation, especially with regard to security.