Cloud Computing: Several Cloud-oriented Solutions

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***Abstract*— Cloud computing is known as an IT environment that includes all elements of the IT and network stack, enabling the development, delivery, and consumption of Cloud Services. In this work in progress paper, we present a brief introduction to the concept of cloud (types and services). Then we outline a state of the art of different existing solutions of cloud. A comparison tables are also proposed.**

Keywords- cloud computing; services; scalability; provisioning.

I. INTRODUCTION

The current network architectures make difficult reusability and increase costs. These architectures not take into account the changing functional requirements at the application development. Faced to costly development, redundant interconnections (point to point), a big complexity and difficulty to maintain, Coud computing and service oriented architecture are a very effective response to these issues in terms of reusability, interoperability and reduce coupling between different systems to ensure their cooperation. Cloud computing is the next generation platform that provides dynamic resources, virtualization and high availability. Cloud computing is not associated with a particular technology, protocol or provider. In practice, applications and data are no longer on the local computer but in a "cloud" composed by a number of remote and interconnected servers. Cloud computing describes a new supplement, consumption and delivery model for IT services based on Internet, and it typically involves the provision of dynamically scalable and often virtualized resources as a service.

Cloud computing offers: Ubiquitous network access, location independent resource pooling, rapid elasticity, self Service and Instant-On, elasticity and Pay-as-you [1].

This paper is divided into two sections. The first one presents types of cloud and models of services in these clouds. Then, the second section describes related works which exposes characteristics of some existing solutions of clouds and comparative tables of these solutions related to infrastructures, platforms and services.

II. CLOUD COMPUTING: TYPES & SERVICES

A. Types of clouds

Three types of cloud could be presented: Public clouds, Private clouds and hybrid clouds.
Public cloud: the services are delivered to the client via the Internet from a third party service provider
Private Cloud: these services are managed and provided within the organization. There is less restriction on network bandwidth, fewer security exposures and other legal requirements compared to the public Cloud.
Hybrid Cloud: there is a combination of services provided from public and private Clouds [2].

B. Models of Service

We find in literature everything as a Service (EaaS). EaaS is the concept of reusable component called across network. It's a subset of cloud computing. "as a Service" was been associated with others functions such as communication (CaaS) or data (DaaS). Three models of service are the most used.
Infrastructure as a Service (IaaS): This model is a modern form of utility computing and outsourcing. IaaS can manage computer resources (networking, storage, virtualized servers). This model allows consumers to deploy and manage assets or leased server instances, while the own service providers govern the underlying infrastructure.
Platform as a service (PaaS): It facilitates the development and deployment of applications without the management of the underlying infrastructure, by providing all necessary equipment to support the entire life cycle of construction and delivery of Web applications and services. This platform consists of software infrastructure, and typically includes a database, middleware and development tools. This type of service typically operates at a high level of abstraction. Users can manage and control resources that they deploy in these environments. Service providers maintain and govern application's environments, server instances, and the underlying infrastructure.
Software as a Service (SaaS): The hosted software or applications are consumed directly by users. Consumers control only the way in which they use cloud services while service providers maintain and manage software, data and the underlying infrastructure [3].

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III. COMPARISION OF SEVERAL CLOUD'S SOLUTIONS

In this section, we describe some platforms of clouds and then we summarize in a comparative tables some characteristics of IaaS then PaaS [4] and SaaS as shown respectively in Table 1 and Table 2.

A. *Eucalyptus*

Eucalyptus for "Elastic Utility Computing Architecture for Linking Your Programs To Useful Systems" is an open source software to implement Infrastructure as a Service in

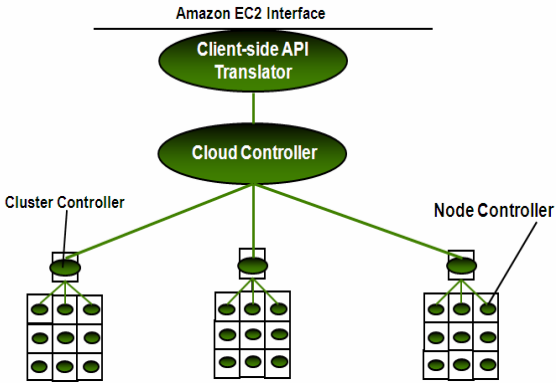

Figure 1. Eucalyptus's Architecture [5]

the cloud. The architecture of eucalyptus is simple, flexible and modular with a design hierarchy as shown in Figure 1.

Three essential components of eucalyptus [6]:

Cloud controller queries information about resources from node managers, makes the scheduling decisions and executes them by using the cluster controllers.

Cluster Controller collects information about a set of virtual machines and schedules their execution on specified node controllers.

Node controller is running on each node that is designated to host virtual machine. It manages the implementation, inspection, and the termination of the VM on the host where it runs.

Users have the ability to execute and monitor virtual machines deployed throughout the physical resources in a flexible, portable, modular and easy manner. The design of eucalyptus gives users the flexibility to seamlessly move applications to Eucalyptus on-premise on the public cloud, and vice versa. Eucalyptus also makes easy the deployment on the hybrid cloud, using resources from public and private clouds for the unique advantages of each [6]. The disadvantage is the lack of an interface to manage virtual machine and an advanced monitoring.

B. *OpenNebula*

OpenNebula is an open source manager of virtual infrastructure [7], able to build private, public and hybrid clouds. OpenNebula offers flexible architecture, interfaces and components that could be integrated into any data center. This tool supports Xen [8] , KVM [9] and VMware [10] and access to Amazon EC2s [11].

OpenNebula was designed to be integrated into any network and storage solution. OpenNebula manages the storage, networking and virtualization technologies to enable the establishment of dynamic multi-level services (groups of interconnected virtual machines) on the distributed infrastructure, combining the resources of physical machines and cloud distance, based allocation policies

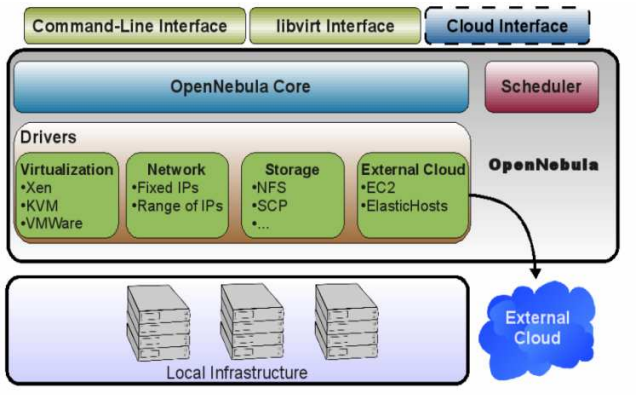

Figure 2. OpenNebula's architecture [12]

OpenNebula consists of three components [13]: *core (Virtual Infrastructure Manager*): Manages the lifecycle of the virtual machine by running the basic operations (deployment, monitoring, migration).

Capacity Manager (scheduler) module that governs the functionality provided by the core of OpenNebula: workloads balancing in virtual machines. *Virtual Access Drivers*: virtualization layer. The drawback of openNebula is the lack of GUI (Graphic User Interface)

OpenNebula provides the "load balancing" across nginx as shown in Figure 3.

Some advantages of OpenNebula [13]:

- Centralized management of the balance of the workload "load balancing", server Consolidation, resizing dynamic infrastructure, partitioning Dynamic Clustering, Support for heterogeneous workloads, and supply virtual machines on demand.

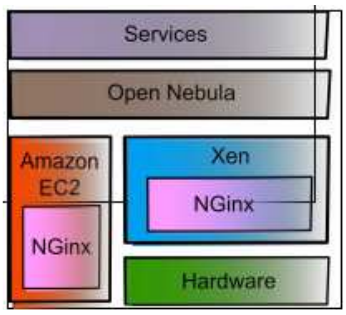

Figure 3. Load balancing in Open nebula [12]

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C. Nimbus

Nimbus is an open source toolkit that provides "infrastructure-as-a-Service». It allows a client to lease resources in distance by deploying virtual machines (VMs), for building a desired environment [14].
Nimbus Cloud Storage offers the model pay-as-you-go and scalability (scale up and scale down as needed without adding expensive infrastructure). It allows customers to reduce costs and eliminate the task of management, giving them the freedom to focus on their business.
Nimbus allows providers to build clouds: Private clouds (Workspace Service: Open source implementation EC2) and developers to experiment with clouds: research or the use / performance improvements and contributions. It requires certain dependencies are installed first. On the service node: Java (1.5 +) and bash. On the nodes of the hypervisor: Python, bash, ebtables, dhcpd, and KVM or Xen libvirt. It supports both interfaces EC2 (Elastic Computing Cloud) and WSRF (Web Service Resource Framework).

D. Abicloud

Abicloud is an open source infrastructure for building and managing public and private clouds based on heterogeneous environments. The tool offers users the ability primarily for scaling, managing, providing automatic and immediate servers and networks [15]. AbiCloud is auto scale: We can change the number of virtual servers, storage and memory. Therefore allows the platform to scale up or down as needed. The platform of AbiCloud is modular because it tries to improve the scalability of the system. The architecture is represented by the Figure 4.
abiCloud_Server: contains the business logic of the global platform of clouds and interacts with the database. *abiCloud_WS*: This virtual assembly line of the platform interacts with various virtualization technologies to manage virtual machines. *AbiCloud_VMS* (Virtual Monitor System) is the component developed to monitor the virtual infrastructure to learn about events or states. *AbiCloud Appliance Manager*: This component enables the management, distribution and scaling (scalability), allowing the import of external applications to the cloud platform.
This component is under development.
AbiCloud Storage Management: This component is currently being formulated and will be dedicated to the integration of storage platform systems. *abiCloud_client*: this web application RIA developed in Flex enables users to manage their private Cloud [15].

E. FlexiScale

The FlexiScale architecture is modular and can accommodate different implementations of its functionality. Virtual Iron is used which is built on the top of Xen Hypervisor and works as an external management layer for the virtual servers. FlexiScale is a Multi-tier architectures enabled by a high-speed internal multiple gigabit Ethernet

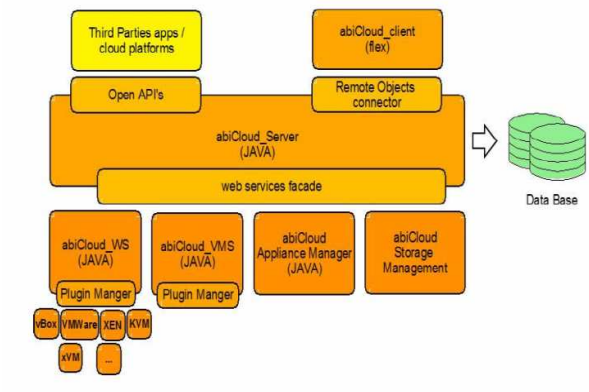

Figure 4. Abicloud's architecture [15]

network. It's a data center architecture which is designed to deliver a guaranteed QoS level for exported services. FlexiScale gives a pay-as-you-go virtual dedicated server. It offers Self-service provisioning of servers via API. Also, Additional servers can be launched in under a minute based on FlexiScale's operating system images or images created by user, highly automated and rapid provisioning of additional processing or storage resources [16].

F. Windows Azure

Windows Azure is Microsoft's offer on Cloud Computing. This is an application platform providing services, accommodation and administration tools. Windows Azure is an operating system for cloud services that serves the development, service hosting and service management environment for the Windows platform Azure [17]. Windows Azure provides developers ability to do computing and storage and also the management of Web applications on the Internet through on demand data center. Windows Azure is a flexible platform that supports multiple languages and could be integrate with the existing environment. In addition, Windows Azure supports popular standards and protocols, including SOAP, REST, XML and PHP. Accommodation Azure will provide a set of scalability features of operating on demand. It is thus possible to obtain and allocate additional processors if the scalability of an application requires it [4].

G. Google appEngine

AppEngine is intended solely for conventional web applications, the application is structured with a clear separation between the third load and the storage. In addition, AppEngine applications should be request-response. AppEngine provides automatic scaling and high availability. For example, AppEngine is not suited for general computing. He admits a fixed topology structure to accommodate the 3-tiers application [18].

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H. *Force.com*

Force.com is a Multi-tenant architecture with metadata driven development model. It means that's a single instance of the hosted application which is able to serve all customers (tenants). Force.com is a SaaS service confined to API. It insures load balancing among tenants. It uses Apex language or database service and supports for .Net, C#, Apache Axis,…Concerning provisioning, with multi-tenant environment, create development, test, staging, training, and production environments are quickly, easily and cost-effectively (in a single tenant environment every new stack must be separately provisioned, managed, and scaled) [19].

IV. CONCLUSION AND FUTURE WORKS

In this paper, we introduced cloud computing overview. We presented layers of clouds, actors and its different types. Then, we summarized some current cloud solutions. Others cloud solutions like IBM solution or EmotiveCloud, Claudia, could be studied in the future in addition to IaaS frameworks. In future works, we will also try to focus on the concept of cloud provisioning and study how Service Oriented Architecture could helps us to perform cloud provisioning in scalable manner.

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TABLE I. COMPARAISON OF SEVERAL IAAS CLOUD'S SOLUTIONS

	Eucalyptus	OpenNebula	Nimbus	AbiCloud	FlexiScale
Service	IaaS	IaaS	IaaS	IaaS	IaaS
Cloud's type	Public / Private	Private	Public	Public/ Private	Public
Scalability	Not Scalable	Scalable	Scalable	Scalable	Scalable
Compatibility	Not support EC2	Multi-platform	Support EC2, WRSF	Support EC2	Not support EC2
VM support	VMware, Xen, KVM	Xen, VMware	Xen	virtualBox, Xen, VMware	Xen Hypervisor
Structure	Module	Module	Component	Module	Module
Provisioning Model	Immediate	Best effort+ haizea: advance reservation, immediate, best-effort + reservoir: Immediate, Best-effort	Immediate	Immediate	Self provisioning
Load balancing	Simple load balancing cloud controller	Nginx as load balancing	auto configuration of virtual clusters s		Automatic with cluster

TABLE II. COMPARAISON OF PAAS AND SAAS CLOUD'S SOLUTIONS

	Azure	Appengine	Force.com
Service	PaaS	PaaS	SaaS
Scalability	Scalable	Scalable	Scalable
VM support	Xen Hypervisor	Multitenant architecture	Multitenant Architecture
Provisioning Model	-	-	Immediate
Load balancing	Should install software	Automatic	Load balancing among tenants
Storage model	SQL Data Services Azure storage service	MegaStore/BigTable	-
Networking Model	Automatic based on programmer's declarative descriptions of app components	Fixed topology to accommodate 3-tier Web app structure	-

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