Recent Trends in Cloud Computing: A Survey

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ABSTRACT

Cloud computing appears to be one of the promising technologies from its stage of infancy. The concepts of cloud computing is based on various technologies like virtualization, grid and utility computing. Without the installation or storage of software in their PC, cloud enable its users to access the shared resources through internet. Most of the IT industries today are moving onto cloud to meet their high computational requirements with reduced cost. The paper gives a brief idea about various concepts involved in cloud computing. The paper also covers the growing trends in the field of cloud computing in detail.

Key words: cloud computing, cloud models, recent trends.

1. INTRODUCTION

Internet has undergone several advancements since its inception. The various technologies like distributed computing and grid computing focuses on efficient utilization of unused resources in the internet. Along with these technologies, the pay-per-usage model and virtualization contributed to evolution of cloud computing. Thus cloud computing allows the users to run any application irrespective of their computational needs [1].Today, there are various cloud service providers like Amazon, Verizon, IBM, Google, Microsoft and Rackspace and so on.

Cloud computing can be defined based upon the kind of service it offers to the end-users. In 1960s, John McCarthy stated that all computational demands can be met by providing resources as utility [4] [2].The National Institute of Standards and Technology (NIST) defines "cloud computing as a model for enabling 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." [5].

The paper includes four sections in which section II provides an overview about current state of cloud computing, section III discusses the recent trends in cloud computing and section IV summarizes this paper.

2. OVERVIEW OF CLOUD COMPUTING

2.1 Layered Model of Cloud Computing

The cloud computing architecture can be modeled into various layers based on the service they provide to the end users. The model in Figure.1 consists of four layers namely hardware layer, infrastructure layer, platform layer and application layer [6].

The Application Layer forms the visible part of the cloud application and the layers underneath are virtualized for the end user. A few examples of applications in this layer include GoogleDocs, YouTube etc. The Hardware Layer consists of the physical hardware needed to carry out the user applications in the cloud environment [6].The third party provider holds the responsibility to control and manage the computational resources. The Infrastructure Layer also called Virtualization layer creates pools of virtual machines which can be created and destroyed according to the customer demands [6]. This layer provides the scalability and flexibility to the cloud. The Platform Layer is built on the top of infrastructure layer which offers a computing platform as a service [6]. This layer enables the consumers to run their applications in the cloud without buying the needed hardware and software [7].

2.2 Cloud Models

Based on the location where the cloud is hosted, we can classify clouds into four types –private, public, hybrid and community cloud [8].

2.1.1   Public Cloud

The whole cloud computing infrastructure is fully controlled by the third party providers like Google, Amazon and opens for the usage of the public based on pay-per-use model [7]. But it offers poor security and hence the data is prone to malicious attacks [3].
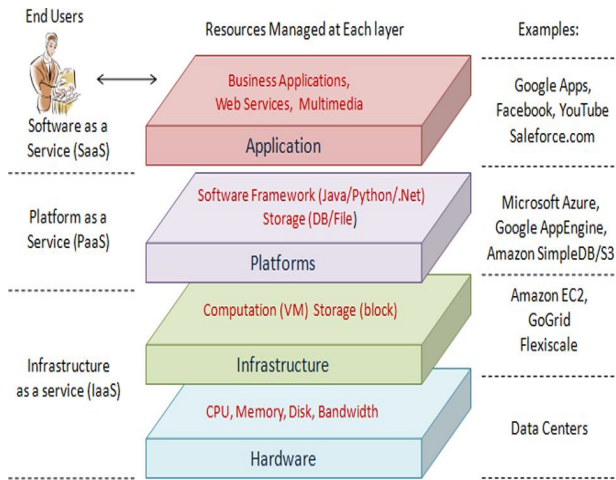
Figure 1: Layered Model

2.1.2 Private Cloud

The purpose of private cloud is to meet the internal computational needs within an organization. This cloud offers more security as it is implemented within the internal firewall. Every aspect of cloud implementation is fully controlled by the organization and hence security will be enhanced [7] [3].

2.1.3 Hybrid Cloud

The combination of private and public clouds forms the hybrid cloud. The organization uses the public cloud services along with its own cloud to perform resource intensive applications [7][3].

2.1.4 Community Cloud

The computing infrastructure created by a group of organizations having similar security interests [8]. Member organizations or a third party provider can hold the responsibility of managing the cloud [1].

2.3. CLOUD SERVICES

Cloud computing can offer the services dealing with the data, software and computation through the internet and hence there are three broad classifications namely IaaS, PaaS and SaaS
 [3] [1].

Infrastructure as a Service (IaaS) provides computing and storage resources as per the requirements of clients [9] [8] .The clients do not have to purchase any servers or data centers and they have to pay for the amount of time they use the resources. Examples include Amazon, Mosso, Sun etc [4] [10].

Platform as a Service (PaaS) provides a computing platform as a service to the users [4]. The entire software and hardware that the client needs to run an application will be offered as a

service [4] [9]. PaaS enables the clients to concentrate on the application rather than the resources required. Google AppEngine, Force.com, Microsoft Azure are a few of the leading companies offering PaaS [10] [8].

Software-as-a-Service (SaaS) provides the entire application as a service to the clients through the internet on demand [1][8]. The user need not to bother about the hardware or software components needed to run the application [1].E-mail is a perfect example for SaaS. The customers of these services do not manage or control the underlying infrastructure and application platform; only limited user-specific configurations are possible. Some of the SaaS vendors are SalesForce.com, Oracle and IBM [10] [8].

3. RECENT TRENDS IN CLOUD COMPUTING

Cloud computing is acquiring more prominence and its applications on various fields of IT are growing in a fast pace from its infancy. The cloud computing technology when merged with existing technologies of computing can revolutionize the ways of data communication and storage.

3.1 Open Source Cloud Computing

With the help of open standards, different technology firms have started powerful cloud services. One of the prominent examples is the creation and development of Hadoop Framework [8]. The framework divides the application into different clusters and assigns to various independent nodes to carry out the work.[15].

Many open source cloud computing platforms with unique set of characteristics are available which meets different kinds of user requirements [11]. A few examples include OpenNebula, Eucalyptus, OpenStack, Nimbus, XCP, CloudFoundry, etc [33][34][12][35][13][14].Comparative study of a few open source platforms has been done and summarized in Table 1.

3.2 Private Clouds

Numerous companies are moving onto private clouds to provide business solutions in an efficient and cost effective manner [16]. Various beneficiary aspects of private clouds are driving Small and Medium Businesses to build private clouds which includes [3] [1].

- Scalable architecture to cater the needs
- On demand resource provisioning
- Improved resource utilization
- Reduced hardware and software costs

The transition to the private clouds includes five major steps [17] as shown in Figure 2. Standardization phase identifies the needed hardware and software resources to build the cloud [17] [18]. Consolidation phase deals with evaluation and centralization of resources that can be managed together which helps to better utilize the less used resources.

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Table 1: Comparison of Open Source Cloud Platforms

| Features	OpenNebula	Eucalyptus	OpenStack	Nimbus	XCP	CloudFoundry
Virtualisation support	Para\full	Para\full	Para\full	Para\full	Para	Para\full
Service used	Iaas	Iaas	Iaas	Iaas	Iaas	PaaS
Cloud Model	Private, public, hybrid	Private hybrid	Public, private	Private	Private\public	Private, public
Architecture	Clustered	Clustered	Distributed	Clustered	Centralized	Distributed
Hypervisor	Xen, KVM, VMware	Xen , KVM, VMware	Xen, KVM	Xen, KVM	Xen	VMware
Written Language	Java, C++,C, Ruby	Java, C	Python	Java ,Python		Ruby on Rails
Features	VM configuration, powerful resource management, Zoning	Flexible Network Management security Groups, Traffic Isolation	Manage LAN, virtual server resources, live VM management, flexible IP addresses	One-click clusters, client tracking, flexible request authentication	Upgrade and patching capabilities, Resource pools, secure communication	Optimized Java web stack, auto scale intelligence, configurable topology

Virtualization phase is the process of creating multiple logical copies of a resource which can be operating system, storage, network or applications which leads to flexibility and cost reduction [19]. Repetitive tasks like provisioning, monitoring and issue reporting regarding resources which are done manually will be automated in the next phase. Orchestration phase deals with dynamically binding all the needed components and providing it to the user as a whole [17].

The features of private cloud is specifically beneficial to Small and Medium Business(SMB) and start-up companies as they can use world-class infrastructure without buying hardware and maintaining large support teams and pay only for what they have used. But a private cloud will function smoothly if a fast, highly reliable network connects the physical servers. For this reason, the entire network infrastructure must be analyzed beforehand. The network must satisfy all the requirements for the private cloud setup or the components have to be upgraded to meet the needs. Ultimately, even minor losses in transmission speed can lead to extreme drops in performance. This means a private cloud also presents new challenges to network monitoring and as the name private, it insists the need of private network monitoring.

3.3 Mobile Cloud Computing (MCC)

The term mobile cloud computing was defined in the Open Gardens blog as the availability of cloud computing services

in a mobile ecosystem especially in smart phones and tablets[20]. The clouds, integrated with the mobile ecosystem,
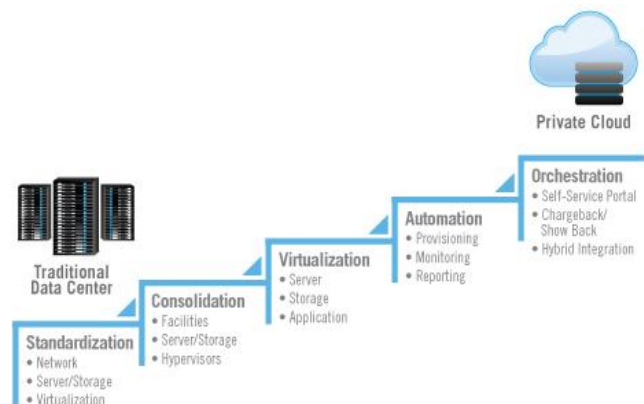
Figure 2: Five steps of moving to private cloud

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manages the computation and storage of data. A few examples include mobile Gmail, Google Maps etc. [21].The limitations associated with mobile devices regarding battery life, storage and processing capabilities will be addressed by the cloud and the mobile user requires a browser to access the applications [22]. A simple architecture of MCC is shown in Figure 3. [23].The mobile devices like smartphones, tablets, iPhones are connected to the cloud through their mobile

networks. Irrespective of the mobile operating system, users can access any application that has a suitable browser.

MCC is in its stage of infancy and it faces various challenges in integrating mobile and cloud computing technologies. Even though the mobile technologies are advancing in a faster pace, the inherent features of mobile devices regarding their storage capacities, processing speed, screen size, battery life etc. possess a serious issue towards implementation of MCC [24]. The wireless connectivity in mobile devices is also a major issue as the data rates and signal strength varies based on network coverage. So MCC technologies should concentrate on resolving issues of reliability, latency and throughput [20][24]. But MCC is a technology to look forward as both mobile and cloud technologies are advancing significantly.
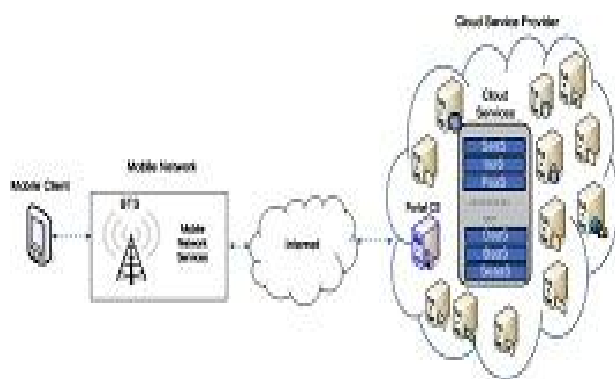

Figure 3: Mobile Cloud Computing

3.4 New Cloud Services

With the ever-growing developments in the field of cloud computing, the services being offered are achieving newer and newer dimensions. Some of the new services include MaaS, C-MaaS, CaaS, DaaS and XaaS.

Monitoring-as-a-Service: MaaS is a service outsourced to enterprises to monitor their applications distributed in the cloud. MaaS concentrates on the various security aspects like integrity, confidentiality of their applications and monitors the cloud environment, dedicated servers or cloud infrastructure [25]. It enables consumers to monitor from one center irrespective of the location of their applications [26][27]. NewRelic, AppDynamics, Coradiant are some of the vendors who offers MaaS [28].

Cloud Migration as a Service (C-MaaS) : deals with migrating servers in-house to cloud setup. It facilitates the customers to move their physical and virtual servers into any cloud computing platform. One such example is Rivermeadow enCloud that enables customers to migrate to cloud in a cost effective manner. It includes four steps in migrating namely Collects, Converts, Deploys and Synchronize [29].

Communication as a Service provides IP communication technologies like VoIP, PBX and VPN as a service through cloud [30]. This eliminates the need to depend on other providers or services to establish communication. The communication can take various forms like e-mails, chats, voice and video calls etc [31].

XaaS or 'anything as a service' refers to any feature provided to customers through cloud rather than depending on in-house technologies. A few XaaS services include Storage as a Service, Unified Communications as a Service (UCaaS), Network as a Service (NaaS), Desktop as a Service (DaaS) etc [32].

4. CONCLUSION AND FUTURE WORK

Cloud computing is an emerging technology which can bring revolutionary changes in the usage of internet. Cloud computing is a combination of various computing technologies and it can play a major role in bringing significant improvement in data transfer and communication. This paper provides a basic understanding of cloud computing which includes the cloud architecture, services and types of clouds. This paper also elaborates the recent trends in cloud computing.

Future work aims at understanding the basic technologies involved in cloud and also to get an insight of various security and privacy issues associated with cloud.

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