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Cloud Computing Topologies and Research Challenges

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Abstract

Cloud computing is an emerging enterprise model in which computing resources like processor, memory storage, programming development model, softwares etc. are made available on-demand at any location to the users. The unique value of cloud computing creates new opportunities to align IT and business goals. Cloud computing use the internet technologies for delivery of IT-Enabled services to users i.e. through cloud computing we can access anything that we want from anywhere to any computer without worrying about anything like about their storage, cost, management and so on. This paper focus on the Cloud Computing topologies and future research challenges in Cloud Computing.

Keywords: *Cloud Computing, PaaS, SaaS, DaaS.*

1. Introduction

An Envisioning the computing utility using the service provisioning model, where resources are available on demand, has led to contemporary computing paradigms that is emerging since the last decade, exploiting technological advances in networked computing environments e.g. peer to peer computing, GRID computing and more recently Cloud Computing[9]. Cloud computing is a infrastructure deployment environment that delivers on-demand services like software, computation, and data base access in a flexible manner by scheduling bandwidth, storage and computing resources on the fly without required end-user knowledge of physical location and system configuration that delivers the service[3].

Cloud computing is a model for providing convenient, on demand network access to a shared pool of computing resources (e.g. servers, storage, applications, network ,computing and services) that can be released with minimal management effort or service provider interaction[20]. Cloud Computing is virtualized computing power and storage delivered via platform infrastructures of abstracted hardware and software accessed over the Internet[1]. These shared, on-demand IT resources, are created and delivered efficiently, are dynamically scalable through a variety of programming interfaces and are billed on pay per use basis. In a traditional hosted environment, these sharable resources are allocated based on peak load requirements. In cloud computing these resources can be dynamically allocated[1].

2. Cloud Computing Services

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)
- Data as a Service (DaaS)

3. Topologies of Cloud Computing Architecture

3.1 Peer to peer Inter-Cloud federation

Clouds are directly collaborated with each other. These clouds may use distributed entities for directories or brokering[9]. Clouds communicate and negotiate directly with each other without mediators shown in figure 1:

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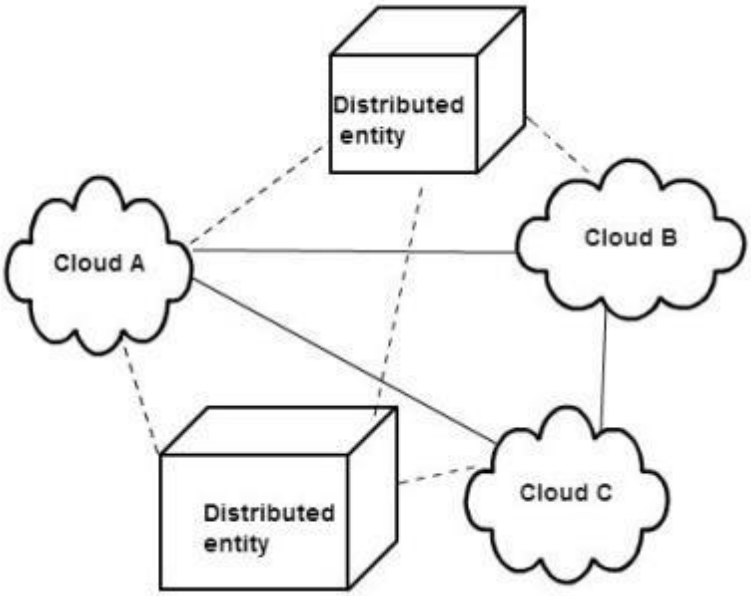

Figure 1: Peer to Peer Inter-Cloud Federation

3.2 Centralized Inter-Cloud federation

Clouds use a central entity to perform or facilitate resource sharing. The central entity acts as a storehouse where the available cloud resources are registered[9]. The Inter-Cloud projects that use Centralized Inter-Cloud federation are Inter-Cloud, Contrail, Dynamic Cloud Collaboration (DCC) and Federated Cloud Management. Centralized Cloud federation is shown in following figure 2:

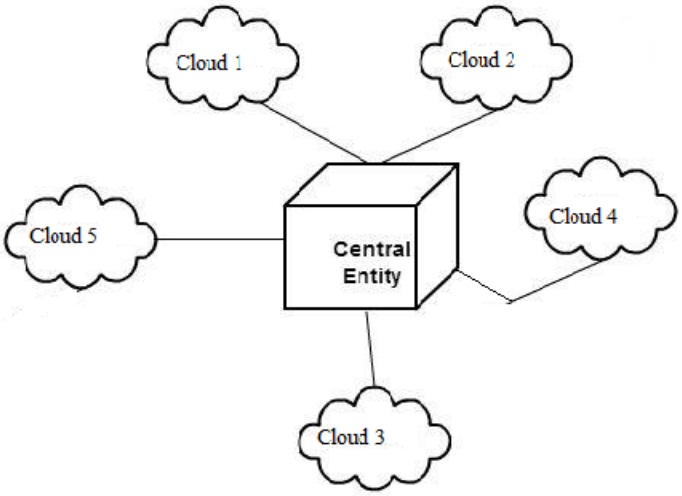

Figure 2: Centralized Cloud federation

3.3 Multicloud Service

Users access multiple clouds through a service. A service is hosted by the cloud client either externally or in-house. The services contain broker components[19]. The Inter-Cloud projects that use Multicloud services are OPTIMIS, Contrail, mOSAIC, STRATOS and Commercial Cloud Manangement Systems. Multicloud service is shown in the following figure 3:

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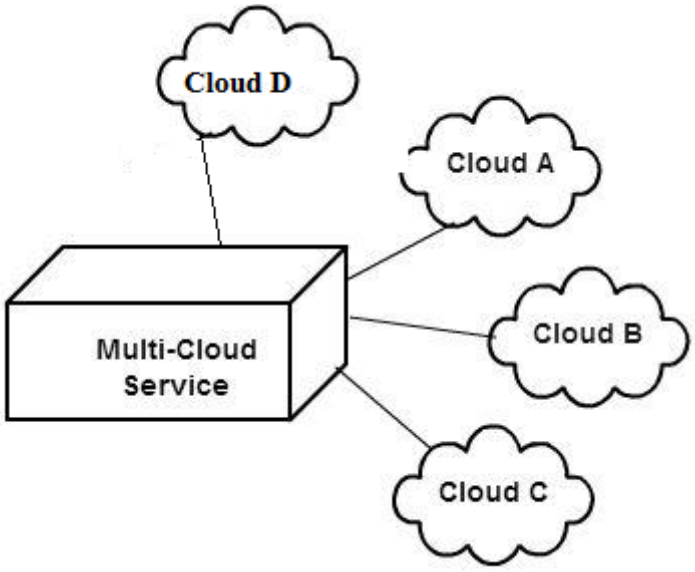

Figure 3: Multicloud Service

3.4 Multicloud Libraries

Clients develop their own brokers by using a unified cloud application programming interface as a library. Inter-Clouds that use libraries facilitate the usage of clouds in a uniform way[20]. Examples of Several Multicloud Libraries are Java library JClouds, Python library Apache LibClouds, Ruby library Apache DeltaCloud, PHP library SimpleCloud.

4. Challenges of Cloud Computing

There are several issues that demand attention but the following could be treated as of prime concern [11,15]:

4.1 Security and Privacy

According to the survey of International Data Corporation (IDC), Performance, Security and Availability are the three main issues in cloud computing adoption[5,6]. The critical challenge is how it addresses security and privacy issues which occur due to movement of data and application across the networks, loss of control on data, heterogeneous nature of resources and various security policies[4]. Data stored, processing and movement of data outside the controls of an organization poses an inherent risk and making it vulnerable to various attacks. The security threats can be of two types viz. internal and external [11,15].

4.2 Automated Service Provisioning

One of the key features of cloud computing is the capability of acquiring and releasing resources on-demand[2]. The objective of a service provider in this case is to allocate and de-allocate resources from the cloud to satisfy its service level objectives, while minimizing its operational cost[5]. However, it is not obvious how a service provider can achieve this objective. In particular, it is not easy to determine how to map service level objectives such as QoS requirements to low-level resource requirement such as CPU and memory requirements. Furthermore, to achieve high agility and respond to rapid demand such as in flash crowd effect, the resource provisioning decisions must be made online. Automated service provisioning is not a new problem[22]. Dynamic resource provisioning for Internet applications has been studied extensively in the past. These approaches typically involve: Constructing an application performance model that predicts the number of application instances required to handle demand at each particular level, in order to satisfy QoS requirements[7].

4.3 Performance

Performance is the another biggest issue in adoption of cloud computing. The cloud must provide improved performance when a user moves to cloud computing environment[8]. Performance is generally measured by capabilities

of applications running on the cloud computing system. Poor performance can be caused by lack of proper resources viz. disk space, limited bandwidth, lower processor speed, memory, network connections etc. Many times users prefer to use services from more than one cloud where some applications are located on private clouds while some other data or applications being on public and/or community cloud. The data intensive applications are more challenging to provide proper resources. Poor performance can results in end of service delivery, loss of customers etc. [11].

4.4 Energy Management

Improving energy efficiency is another key issue in cloud computing adoption[21]. It has been estimated that the cost of powering and cooling the hardware system accounts for 53% of the total operational expenditure of data centers[18]. In 2006, data centers in the US consumed more than 1.5% of the total energy generated in that year, and the percentage is projected to grow 18% annually. Hence infrastructure providers are under enormous pressure to reduce energy consumption in cloud computing environment[10]. The goal is not only to reduce energy cost in data centers, but also to meet government regulations and environmental standards. Designing energy-efficient data centers has recently received considerable attention[13]. This problem can be approached from several directions. For example, energy efficient hardware architecture that enables slowing down CPU speeds and turning off partial hardware components has become commonplace. Energy-aware job scheduling and server consolidation are two other ways to reduce power consumption by turning off unused machines in cloud environment[12].

4.5 Reliability and Availability

Reliability and availability are key issues in adoption of cloud computing environment[16]. Reliability denotes how often resources are available without disruption (loss of data, storage not available, CPU busy, code reset during execution) and how often they fail. One of the important aspect that creates serious problems for the reliability of cloud computing is down time. One way to achieve reliability is by having redundant resources of each type[14]. Availability can be understood as the possibility of obtaining the resources whenever they are needed with the consideration to the time it takes for these resources to be provisioned.

4.6 Server consolidation

Server consolidation is an effective approach to maximize resource utilization while minimizing energy consumption in a cloud computing environment[17]. Live VMmigration technology is often used to consolidate virtual machines residing on multiple under-utilized servers onto a single server, so that the remaining servers can be set to an energy-saving state. The problem of optimally consolidating servers in a data center is often formulated as a variant of the vector bin-packing problem, which is an NP-hard problem. Various heuristics have been proposed for the solution of this problem.

5. Conclusion

This paper introduce the cloud computing.. It also discuss furure challenges of cloud computing. Cloud computing is becoming a hugely attractive paradigm, especially for large enterprises. Cloud Computing initiatives could affect the enterprises within two to three years as it has the potential to significantly change IT. The paper has discussed the concept of cloud computing topologies and shades some lights on various challenges that needs to be addressed in order to realize the implementation of the cloud computing effectively.

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