A View of Cloud Computing: Bringing the Data Center Design into the Realm of Enterprise Architecture

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Abstract

The explosion of data , its criticality , and business and education 's growing dependency on digital information are leading to larger and more complex information storage environments that increasingly combating to manage the processing of data—acquiring, capturing ,analyzing, securing ,sharing and most of all. Data centers need to keep up with these facts, and are always in a constant state of transformation. There are several challenges to consider when designing a solution for provisioning and maintenance of infrastructure for data centers. Within the past few years , a powerful new strategy has emerged that has important influences in data center architectures .This is the paradigm of cloud computing , which allows data centers to avoid locally hosting multiple servers and equipment and constantly deals with hardware failure, software installs, upgrades and compatibility issues. This paper presents on the cloud computing in details and, how far the architecture is being applied, especially for data centers in universities and colleges as well as its appreciable benefits.

Keywords: cloud computing, data, data centers

1. Introduction

Cloud computing, the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with innovative ideas for new Internet services no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. They need not be concerned about over provisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under provisioning for one that becomes wildly popular, thus missing potential customers and revenue. One of the advantages of cloud computing, the elasticity of resources, without paying a premium for large scale, is unprecedented in the history of IT.

The Data centre is a development-oriented hardware and software integration platform, through to technical and the product incorporation, each kind of carrier digitization, carries on the effective deposit and the organization, provides the network the effective service. After the data center technology popularization, provided the high grade information service but simultaneously also to expose all sorts of questions unceasingly, because the zones of different the current economic condition limit presented the development not balanced phenomenon, the regional resources shared with difficulty, form each one information isolated island or the resources are redundant, create the resources the waste, satisfied the aggregate demand with difficulty, the cloud computing possibly provides a good plan day by day for this kind of phenomenon.

In this paper we discuss , the data centers , as a typical representative of the applications of cloud computing, can be used to carry out an analysis on the key technologies of the cloud computing. The rest of the paper is organized as follows: In section 2, we mention the overview of cloud computing. Section 3 describes the effects of virtualization and the proposed framework in section 4. And, section 5 introduces the impacts of the proposed framework and section 6 the conclusion.

2. Cloud Computing: An Overview

Depending on an organization's needs and requirements, different technologies and configurations are suitable. To understand which part of the continuum of cloud systems is most credible for a given need, an organization should think about how clouds can be deployed (deployment models), what kinds of services can be provided to customers (service models), the economic opportunities and risks of using cloud services (economic considerations), typical terms of service (service level agreements),the security opportunities and an risk.[2]

2.1. Deployment Models

Cloud computing is defined to have several deployment models, each of which provides distinct trade-offs for agencies which are migrating

applications to a cloud environment [5][8]. The cloud deployment models can be defined as follows:

Private cloud: The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.
Community cloud: The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations).It may be managed by the organizations or a third party and may exist on premise or off premise.
Public cloud: The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.
Hybrid cloud: The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

2.2. Service Models

The two most significant components of cloud computing architecture are known as the front end and the back end. The front end is the part seen by the client, i.e., the computer user. This includes the client's network (or computer) and the applications used to access the cloud via a user interface such as a web browser. The back end of the cloud computing architecture is the *cloud* itself, comprising various computers, servers and data storage devices [9].

Cloud computing can also categorized into service models. These are defined as follows:

Cloud Software as a Service (SaaS): The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email).The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings. The most extensively known example is salesforce.com. Google Apps also offering basic business services including email and word processing. Services like Quicken online, various search engines, social networks, Wikipedia, encyclopedia Britanica on the Internet are also falls into this category [12].

Cloud Platform as a Service (PaaS):The capability provided to the consumer is the ability to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations. Examples are Mosso, Heroku, GoogleApp engine, Engine Yard, Joyent and Force.com(sales Force platform).The service being sold is the machinery that funnels requests to an application and makes the application tick [12].

Cloud Infrastructure as a Service (IaaS): The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls). Amazons' EC2, Eucalyptus, Go Grid, Right Scale and Linode are examples of IaaS [12].

2.3 Economic Considerations.

In outsourced and public deployment models, cloud computing provides convenient rental of computing resources: users pay service charges while using a service but need not pay large up-front acquisition costs to build a computing infrastructure. The reduction of up-front costs reduces the risks for pilot projects and experimental efforts, thus reducing a barrier to organizational flexibility, or agility. In outsourced and public deployment models, cloud computing also can provide elasticity, that is, the ability for customers to quickly request, receive, and later release as many resources as needed. By using an elastic cloud, customers may be able to avoid excessive costs from over-provisioning, i.e., building enough capacity for peak demand and then not using the capacity in non-peak periods. Whether or not cloud computing reduces overall costs for an organization depends on a careful analysis of all the costs of operation, compliance, and security, including costs to migrate to and, if necessary, migrate from a cloud. **[2]**

2.3. Service Level Agreements (SLAs)

Organizations should understand the terms of the SLA, their responsibilities, and those of the service provider, before using a cloud service. A subscriber's terms of service for a cloud are determined by a

legally binding agreement between the two parties often contained in two parts: (1) a service agreement, and (2) a Service Level Agreement (SLA). Generally, the service agreement is a legal document specifying the rules of the legal contract between a subscriber and provider, and the SLA is a shorter document stating the technical performance promises made by a provider including remedies for performance failures. For simplicity, this publication refers to the combination of these two documents as an SLA.[11]

2.4 Security

As complex networked systems, clouds are affected by traditional computer and network security issues such as the needs to provide data confidentiality, data integrity, and system availability. By imposing uniform management practices, clouds may be able to improve on some security update and response issues. Interestingly, the security concerns in a cloud environment are no different from a traditional data center and network. However, since most of the information exchange between the organization and the cloud service provider is done over the Web or a shared network, and because IT security is handled entirely by an external entity, the overall security risks are perceived as higher for cloud services. Some additional factors cited as contributing to this perception:

– Limited knowledge of the physical location of stored data

– A belief that multi-tenant platforms are inherently less secure than single-tenant platforms

– Use of virtualization as the underlying technology, where virtualization is seen as relatively new technology

– Limited capabilities for monitoring access to applications hosted in the cloud.

– Speed / Lack of Internet can affect work methods [**7]**

3. The effects of Virtualization

Cloud computing is an emerging research infrastructure that builds on the achievements of different research areas, such as service-oriented architecture (SOA), grid computing, and virtualization technology. It offers infrastructure as a service that is based on pay-as-you-use and on-demand computing models to the end users. To provide this cloud computing service, the provisioning of the cloud infrastructure in data centers is a prerequisite.[7] In this section, we shall focus on one of the core services known as virtual machine provisioning that enables users to get the best out of the IaaS model in public and private cloud setups. Virtualization has revolutionized data center's technology through a set of techniques and tools that make possible the conditioning and management of the dynamic data center's infrastructure. It has become an essential and enabling technology of cloud computing environments. Virtualization can be defined as the abstraction of the four computing resources (storage, processing power, memory, and network or I/O). It is conceptually similar to emulation, where a system pretends to be another system, whereas virtualization is a system pretending to be two or more of the same system.[3]

Actually, the virtualization layer will partition the physical resource of the underlying physical server into multiple virtual machines with different workloads as shown in figure 1[7]. The fascinating thing about this virtualization layer is that it schedules, allocates the physical resource, and makes each virtual machine think that it totally owns the whole underlying hardware's physical resource (processor, disks, rams, etc.) [4]

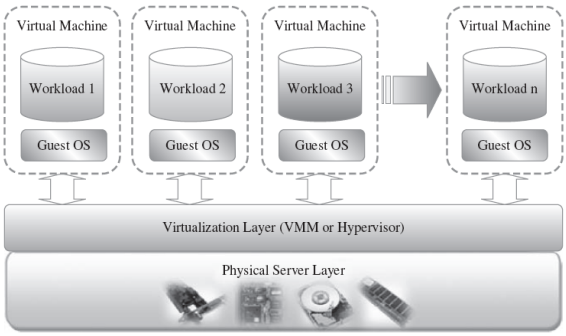

Figure 1. Layered virtualization technology architecture

Virtual machine's technology makes it very flexible and easy to manage resources in cloud computing environments, because they improve the utilization of such resources by multiplexing many virtual machines on one physical host (server consolidation). Furthermore, these machines can be scaled up and down on demand with a high level of resources' abstraction. Virtualization enables high, reliable, and agile deployment mechanisms and management of services, providing on-demand cloning and live migration services which improve reliability. Accordingly, having an effective management's suite for managing virtual machines' infrastructure is critical for any cloud computing infrastructure as a service (IaaS) vendor.[7]

4. Proposed Framework

4.1 Simplified Structure of University Cloud

By using a cloud model and applications based on cloud, students can obtain the advantage of the ability of working and communicating in the educational environment without taking into account space and time.

The teaching staff shall benefit of support in preparing their teaching portfolio in teaching practice (methods and teaching techniques, study materials, feedback) and in evaluating (methods and techniques of evaluation and management of the results).

Researchers will benefit from the advantage of using the latest technologies, experimenting the results and communication, while paying for using this services. Developers may design, build and test applications that are executed on the infrastructure of the cloud provider and deliver those applications directly from the servers of the provider to the final users.

System administrators obtain general processing, storage, database management and other resources and applications through the network. The rest of the administrative staff will benefit from services and infrastructure, from everywhere anytime at low costs. Simplified structure of the main users of IT services in a typical university now using the services of cloud computing is shown in the following figure 2.

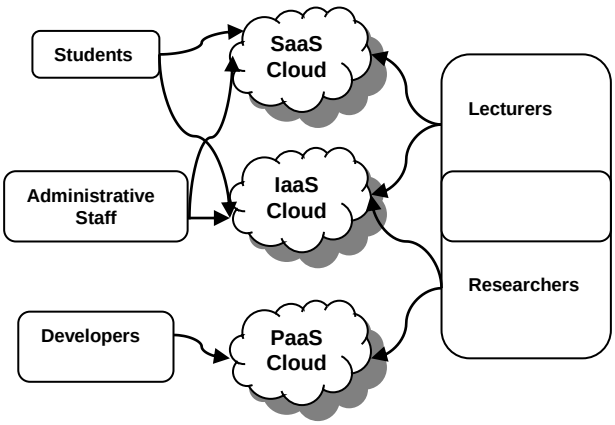

Figure 2. Simplified Structure of University Cloud

4.2 Underlying Architecture of University Cloud

In this section, the underlying network architecture of a university's data center can be clearly seen from the following figure 3. Together with the network peripherals described in the figure, choosing the appropriate UPS for sufficient electricity dispensation and the amount and arrangement of racks for minimizing the heat dissipation, cooling and air-conditioning cost.[6]

Our study provides a convenient, along with the increasing knowledge level, the requirement of data center and growing. But because of uneven economic development in different regions causes the data center's resources to be relatively short, to university data center as an example. Various colleges and universities while are raising the respective teaching level unceasingly, have established a data center to purchase its own database resources, but because of the teaching focus and economic conditions, data centers' resources between university's has the differences, meanwhile looked from the whole that the data center has certain flaw. Data resources between various universities are relatively independent, building redundant projects possibility was high, has created the manpower, the financial resource and the resources waste, or some colleges and universities to use only part of database

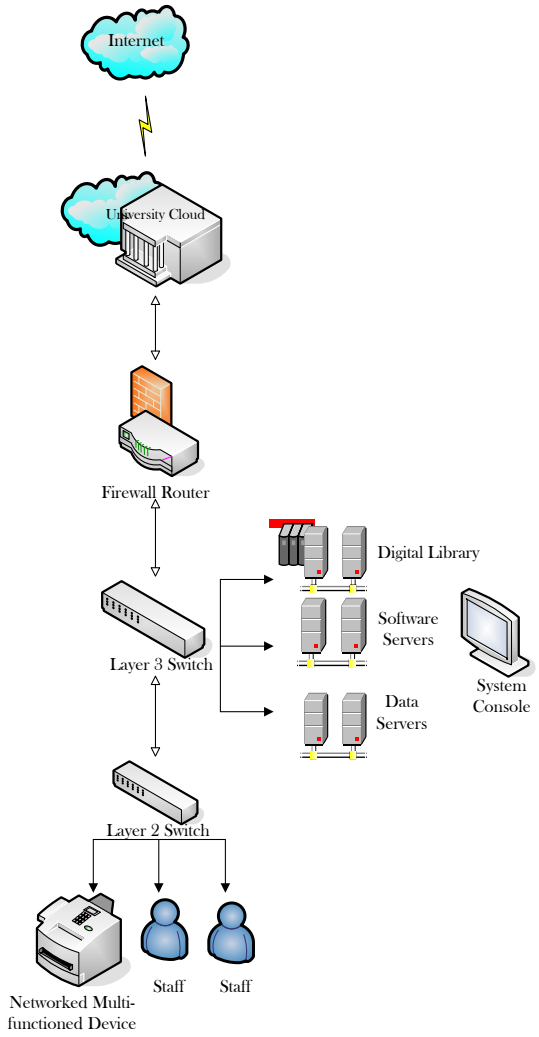

Figure 3. Architectural View of University Cloud

resources, inadequate use of resources, and cannot play resources maximum utilization.

Based on cloud computing in the cost calculation, performance, team cooperation and the advantages of the geographic location, because simultaneously the different application procedure has used the different mutually independent platform, each application procedure completes on own server. Using cloud computing can share the server in many application procedures, realizes the resource sharing, thus also reduced server's quantity, achieves the effect of reducing the cost, therefore utilizes cloud computing in the data center, will give our work, the life and the study inevitably obtains a greater efficiency, as shown in figure 4.

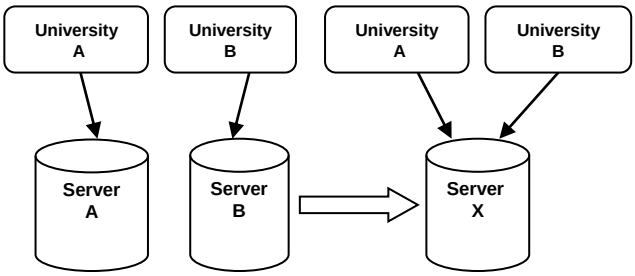

Figure 4. Server Share Plan

Every cloud computation's server may be the computation server, saves the server or the wide band resources and so on, in figure 5 every cloud represents any university database resources, every two clouds or more clouds may compose a bigger cloud, may divide the cloud or the composition cloud by the different regions either the different rank university. Saas, Software as a Service, through the browser to the form of services provided to the applications, to users and suppliers to reduce costs. Paas, Platform as a service, defined by the form of services provided to the developers application development and deployment platform, so that they can use this platform to develop, deploy and manage SaaS applications. This platform typically includes a database, middleware and development tools, all are in the form of services through the Internet. IaaS , infrastructure as a service, defined by the form of services to provide servers, storage and networking hardware.

5. The Impacts of the proposed framework

With the rapid development of various IT technologies, users' information requirements are increasingly personalized. And now more and more data centers advocated user-centered services. So the staff at the data centers should mine and study users' information requirements frequently. And only in this way, they can master the basic demands of their users. And furthermore, data center can develop itself according to such information and improve users' satisfaction. University data center, as we all know, is famous for its academic and teaching influences. And IT technology has been the driving force of data center development. What's more, new technology can be kept using to develop data center and optimize its services. With the expansion of Cloud Computing application, this paper proposed to apply Cloud Computing in Data Center. By establishing a pubic cloud among many university data centers, it not only can conserve data center resources but also can improve its user satisfaction.

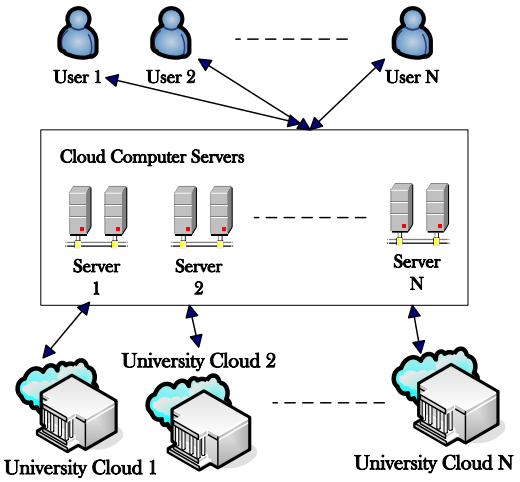

Figure 5. Data Servers and the cloud

Driven by Cloud Computing, **CDRS (Cooperative digital reference service)** can realize the sharing of technology, resources, experts and services of university data centers.

By introducing Cloud Computing, university data centers can establish a shared public cloud jointly .As shared cloud can have infinite storage capacity and computing power theoretically. It can bring obvious benefits to data centers. On one hand, allied data centers no longer consider the hardware cost; on the other hand, it can help reduce the purchase of electronic database resources repeatedly among them .Meanwhile, users can visit the shared resources by any terminal equipment, such as PC, mobile phone or PDA only if one can access to the Internet.

The professors, teachers or students, all the people of that country can access to the data center resources. In addition, they also permit users access to many data centers' resources by handling related certificate of that data center. And fortunately, domestic data center can also do this in the cloud environment. Anybody who can through the legal network identity authentication has the right to visit

the joint resources of university data centers on the Internet In other words; university data center will offer services for all the people with the help of Cloud Computing.

6. Conclusion

We know that data centers are not only a knowledge ocean, its ultimate aim is to provide satisfactory services for all the people. And in this paper, we attempted to present significant improvements in university data center by applying Cloud Computing technologies. Although study of Cloud Computing is still in the initial stage now, impacts brought by Cloud Computing are obvious. And we all believe that data centers will create more knowledge benefits for our country with the help of Cloud Computing. Cloud environment is a highly developed network environment; it appears to the users of high-quality service and high security. The Cloud computing techniques and methods applied to data centers, not only can improve the utilization rate of resources to address the imbalance in development between regions, but also can make more extensive use of cloud computing to our work life.

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