Global Journal of Computer Science and Technology
Volume 11 Issue 11 Version 1.0 July 2011
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Research Issues in Cloud Computing

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GJCST Classification : C.1.4, C.2.1

Strictly as per the compliance and regulations of:

Research Issues in Cloud Computing

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Abstract : Cloud computing moved away from personal computers and the individual enterprise application server to services provided by the cloud of computers. The emergence of cloud computing has made a tremendous impact on the Information Technology (IT) industry over the past few years. Currently IT industry needs Cloud computing services to provide best opportunities to real world. Cloud computing is in initial stages, with many issues still to be addressed. The objective of this paper is to explore the different issues of cloud computing and identify important research opportunities in this increasingly important area. We present different design challenges categorized under security challenges, Data Challenges, Performance challenges and other Design Challenges.

I. Introduction

Cloud computing [1] recently received considerable attention, as a promising approach for delivering Information and Communication Technologies (ICT) services. With the fast development of processing, storage technologies, the sensation of the Internet, and computing resources have become cheaper, more powerful and more universally available than ever before. This technological trend has enabled the realization of a new computing model called cloud computing. The resources like CPU and storage are provided as general utilities to the users on-demand based through internet. The traditional cloud computing service provider is divided as the *infrastructure providers* who supervise cloud platforms and lease resources according to a pay-per-use based model, and *service providers*, who rent resources from more infrastructure providers to serve the end users. From the past few years , the cloud computing has made a tremendous impact on the Information Technology (IT) industry, where large companies such as Google, IBM, Amazon and Microsoft struggle to provide more powerful, reliable and cost-efficient cloud platforms, and business enterprises seek to find new paradigm in their business models. Indeed, cloud computing provides several compelling features that make it attractive to business owners, like *Less up-front investment, Lowering operating cost, Highly scalable, Easy access, Reducing business risks and maintenance expenses.*

The paper is organized as follows. Section II discusses the services provided by cloud environment. Section III to Section VI exploits the design issues in cloud environment.

Section III explains the Security issues in cloud environment, Section IV explains the Data Issues, Section V explains Performance Issues in Cloud Environment and Section VI explains the Other Design Issues. We conclude the paper in Section VII.

II. Cloud Computing Services

The basic services of Cloud have been considered as the following.

Platform as a Service (PaaS) : PaaS is an application development and deployment platform provided as a service to developers over the Web. Middleman's equipment can be used to develop programs and transfer it to the end users through internet and servers. The Cost and Complexity of Development and Deployment of Applications can be reduced to a great extent by developers by using this service. Thus the developers can reduce the cost of buying and reduce the complexity of managing the required Infrastructure. It provides all of the services essential to support the complete life cycle of building and delivering web applications and all the services entirely available from the Internet. This platform consists of infrastructure software, a database, middleware, and development tools.

Infrastructure as a Service (IaaS) : IaaS is the delivery of associated Software and hardware as a service. Hardware like server, storage and network, and associated software like operating systems, virtualization technology and file system. It is an evolution of traditional hosting to allow users to provide resources on demand and without require any long term commitment. Different PaaS services, the IaaS provider does very little management other than keep the data center operational and end-users must deploy and manage the software services themselves-just the way they would in their own data center.

Software as a service (SaaS) : SaaS reassign programs to millions of users all the way through browser. For user, this can save some cost on software and servers. For Service provider's, they only need to maintain one program, this can also saves space and cost. SaaS provider naturally hosts and manages a given application in their own or leased datacenters and makes it available to multiple tenants and users using the Web. Some SaaS providers run on another cloud provider's IaaS or PaaS service contributions.

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III. Security Issues

In this section we will review some of the security issues in Cloud Environment.

a) Availability of Service

Most of the Organizations are some cautions of cloud computing and sufficient availability is existing in Utility Computing services. In this view, all available SaaS products have a high standard. Users expect high accessibility from cloud facilities; it is very attractable for large customers with business-continuity opportunity to transfer to Cloud Computing in critical situations. It is possible to accept for different companies to provide independent software stacks for them, but it is very hard for single organization to justify maintain and create more tan one stack in the name of software dependability.

And one more availability problem is Distributed Denial of Service (DDoS) attacks Attackers makes use of large botnet's to reduce the profits of SaaS providers by DDoS by making their services unavailable [2].

A long botnet attack may be difficult to maintain, since the longer an attack lasts the easier it is to uncover and defend against, and on the same provide, these attacking bots could not be immediately re-used for other attacks.

These attacks are shifts by cloud computing to the Utility Computing provider from the SaaS provider. In this, who can more willingly absorb it and it also maintains DDOS protection in this competency.

b) Data security

Data security is another important research topic in cloud computing. Since service providers does not have permission for access to the physical security system of data centers. But they must depend on the infrastructure provider to get full data security. In a virtual private cloud environment, the service provider can only specify the security setting remotely, and we don't know exactly those are fully implemented. In this Process, the infrastructure provider must reach the following objectives: (1) *confidentiality*, for secure data transfer and access, and (2) *auditability*, whether applications security setting has been tampered or not.

Confidentiality is usually achieved using cryptographic protocols, unencrypted data in a local data center in not secure compare to the encrypted data in before place into cloud. Auditability can be achieved using remote attestation techniques and it could be added as an extra level away from of the virtualized guest Operating System, in one logical layer maintain some responsible software related to confidentiality and auditability.

Remote attestation typically requires a trusted platform module (TPM) to generate non-forgeable system summary as the proof of system security. In virtual environment, Virtual Machine can change dynamically the location from one to other . It is very difficult to construct trust mechanism in every architectural layer of the cloud. Virtual Machine migration should only if both source and destination servers are trusted [3].

IV. Data Issues

In this section we exploit some of the Data issues in Cloud Environment.

a) Data Lock-In

Software stacks have better interoperability between platforms, but customers feels difficult to extract their programs and data from one location to run on another. Some organizations are concerned about extracting data from a cloud due to which they don't opt for cloud computing. Customer lock-in seems to be striking to Cloud Computing providers. Cloud Computing users are more worried about increase in price, consistency problems, or even to providers leaving out of business. SasS developers could take the advantage of deploying the services and data on multiple Cloud Computing providers so that failure of a single company does not affect the customer data. The only fear is that they are much worried about the cloud pricing and flatten the profits. We offer two advices to relieve this alarm. First, the quality is also important compare to the price , then customers will not not attract and offer to the lowest cost service. Second, It Concerns data lock-in justification, APIs standardization leads to a new model for Private Cloud and a Public Cloud with same software infrastructure usage. This option Available in "Surge Computing," due to high workloads it is not easy to run extra tasks in private clouds compare to the public cloud [4].

b) Data Transfer Bottlenecks

Applications maintain to be converted into additional data-intensive. The applications are moved across the boundaries of clouds may complicate data placement and transport. Cloud providers and users have to feel about to minimize costs on the concept of the traffic and the implications of placement at each level of the system. One provision is to overcome the high cost of bandwidth transfers is to ship disks. It is one more provision to keep maintains data in the cloud. If the data is in the cloud, it may not be a bottleneck to enable a new service. If archived data is in the cloud, selling of Cloud computing cycles with the new services become possible, such in all your archival data by creating searchable indices or group the images according to who appears in each photo by performing image recognition on all your archived photos.

A third opportunity is to minimize the cost of network bandwidth more quickly. One estimate is that one-third is the fiber cost where as two-thirds of the cost of WAN bandwidth is the cost of the high-end routers. Some Researchers are exploring lower cost with

Centralized control routers instead of the high-end distributed routers. If this technology were deployed in WAN then WAN costs dropping more quickly.

c) Traffic management and analysis

Analysis of data traffic is important for today's data centers. However, there are several challenges for existing traffic measurement and analysis methods in Internet Service Providers (ISPs) networks and enterprise to extend to data centers. Firstly, the density of links is much higher than that in ISPs or enterprise networks, which makes the worst case scenario for existing methods. Secondly, most existing methods can compute traffic matrices between a few hundred end hosts, but even a modular data center can have several thousand servers. Finally, existing methods usually assume some flow patterns that are reasonable in Internet and enterprises networks, but the applications deployed on data centers significantly change the traffic pattern. Further, there is tight coupling of application's use to network, computing, and storage resources, than what is present in other settings. Currently, the work on measurement and analysis of data center traffic is very less. Greenberg et al. [5] report data center traffic characteristics on flow sizes and concurrent flows, and use these to guide network infrastructure design. Benson et al. [6] perform a complementary study of traffic at the edges of a data center by examining SNMP traces from routers.

d) Reputation Fate Sharing

Reputations may not suit well for virtualization. Reputation of the cloud as a whole may be affected by one customer's bad behavior. In hosted smaller ISP's, we are offering with some cost is the "trusted email" services and with some experience in of this problem to create reputation-guarding services. Another important concept in cloud computing provider's legal issue is transfer of legal liability and it maintain by customer.

V. Performance Issues

a) Virtual machine migration

Virtual Machine migration provides major benefit in cloud computing through load balance across data centers. It also provides robust and high response in data centers. Virtual machine migration was extended from process migration. Avoiding hotspots is major benefit of VM migration even though it is not straight forward. Initiating a migration lacks the facility to respond to unexpected workload changes and detecting workload hotspot.

It should be transferred effectively in migrating process the workload in memory state. During the transfer it maintains consistency for applications by considering resources and physical servers.

b) Server consolidation

In a cloud computing environment, Server consolidation is an efficient approach is to minimize the energy consumption for makes best use of resource utilization. In a single server to consolidate VMs residing on multiple under-utilized servers by using Live VM migration technology and all the remaining servers can be set to an energy-saving state. Server consolidation is not depend on application performance .It is known as the resource usage means individual VMs may vary time to time. Result in resource congestion by change of footprint in VM on the server. Sharing of resources (i.e., disk I/O, bandwidth and memory cache) among VMs on server leads resource congestion. This information is useful for effective server consolidation and the fluctuations of VM footprints.

When the resource congestions are occur, then the system react quickly.

c) Performance Unpredictability

Sharing I/O is complex in cloud computing while multiple virtual machines can share CPU and main memory easily. Virtualization of I/O interrupts and channel is one solution to improve the efficiency of operating system and improve architecture. Some of the technologies like PCI express which are very critical to the cloud are difficult to virtualize. Flash memory could be an attractive alternate with reduced I/O interference. It can provide possibility for multiple virtual machines to share I/O per second with more storage capacity. Multiple virtual machines with random input/output workloads can coexist in a single physical machine without the interference.

Another unpredictability problem concerns to scheduling of virtual machines for various classes of batch processing programs, exclusively for high performance computing [7]. The complication to attracting HPC is not the use of clusters; the majority of parallel computing at present is done in huge clusters using the message-passing interface MPI. The problem is that various HPC applications require to ensure that all the threads of a program are running simultaneously and today's virtual machines and operating systems do not provide a programmer-visible way to ensure this. Gang Scheduling [8] can be used to overcome the obstacle in cloud computing.

d) Scalable Storage

Cloud Computing important properties are: infinite capacity on-demand, no up-front cost, short-term usage. This is an open research problem, is not only create storage system [9] to meet these issues. And consider cloud advantages of programmer expectations and scaling arbitrarily up and down on-demand in regard to resource organization for high availability, data durability and scalability.

e) Bugs in Large-Scale Distributed Systems

Another challenge issue in Cloud Computing is removing errors in these large scale distributed systems. The debugging of these bugs have to be done at large

scale in the production data centers as these bugs cannot be reproduced in smaller configurations.

One prospect may be to depend on virtual machines in Cloud Computing. SaaS providers developed their infrastructure without VMs. SaaS providers did not opt for VMs as they preceded the recent popularity of VMs or as they felt they could not afford the performance of VMs. Since VMs are very important in Utility Computing, that level of virtualization may make it possible to capture valuable information in ways that are unlikely without VMs.

f) Scaling Quickly

Pay-as-you-go certainly applies to network bandwidth and storage on the basis of used bytes count. Depending on the virtualization level, computation is slightly different. Google AppEngine automatically scales in response to load up and down, and users are charged by usage of the cycles. AWS charges on for the number of instances you occupy by the hour without checking if your machine is idle or not.

One more opportunity without violating service level agreements is automatically scale quickly increase and decrease in reply to load in order to save money, but another reason for scaling is to save money as well as resources.

About two-thirds of the power in idle computers use compare to the busy computer. Currently, in datacenters on the environment receiving a great deal of negative attention But careful use of resources could reduce the impact.

Cloud Computing providers already get low overhead and careful accounting of resource consumption. By imposing to pay attention to encourages programmers in the concept of efficiency are utility computing, per-hour and per-byte costs, development inefficiencies, and allows more direct measurement of operational.

g) Latency

Latency is a research issue on the Internet. Any performance in the cloud is going the same meaning of the performance of the result on the client. The latency in a cloud introduces not to be tedious. The latency is compressed back for understand how and where they're running with both smartly-written applications and an intelligently planned infrastructure. In future, cloud computing capacity and cloud based applications are rapidly increases and latency is also increases. Cloud computing latency must be improved in the desktop PC is largest bottlenecks in the memory and storage.

VI. Other Design Issues

a) Energy management

Improving energy efficiency is another major issue in cloud computing. It has been estimated that the cost of powering and cooling accounts for 53% of the total operational expenditure of data centers [10]. Infrastructure providers are to reduce energy consumption under enormous pressure. In data centers, the aim are only to reduce energy is cost. Data centers are recently received considerable attention on designing energy-efficient data centers. This approach leads to several directions. For example, energy efficient hardware architecture that enables slowing down CPU speeds and turning off partial hardware components [11] has become commonplace. Energy-aware job scheduling and server consolidation [12] are two other ways to reduce power consumption by turning off unused machines. Current research on energy-efficient network protocols and infrastructures [13]. To achieve a good trade-off between energy savings and application performance is key challenge. Some of the researchers have recently work on the solutions for performance and power management in a dynamic cloud environment.

b) Software frameworks

Cloud computing provides a persuasive platform for hosting significant data-intensive applications. In this, Hadoop for scalable and fault-tolerant data processing by using applications leverage Map Reduce frameworks concept. A MapReduce job is highly dependent on the type of the application [14] and show that the performance and resource consumption. All Hadoop nodes have heterogeneous characteristics which are allocated by Virtual Machine. Hence, it is possible to optimize the performance and cost of a MapReduce application by carefully selecting its configuration parameter values and designing more efficient scheduling algorithms [15]. In the bottleneck resources, It significantly improved by execution time of applications. The design challenges include performance modeling of Hadoop jobs in all the possible cases, and dynamic conditions in adaptive scheduling. MapReduce frameworks energy-aware [16] is another approach to turn Hadoop node into sleep mode after it has finished its work while waiting for new assignments. Made energy-aware are Hadoop and HDFS. Some researchers are still working on a trade-off between performance and energy-awareness.

c) Novel cloud architectures

Large data centers and operated in a centralized fashion is implemented as commercial clouds. In this design achieves high manageability and economy-of-scale. But Some limitations in large constructing data centers such as high initial investment nd high energy expense. Some researchers [17] suggests that small size data centers can be more advantageous than big data centers in many cases: a small data center consume less power, So it does not require a powerful and high expensive cooling system; Comparatively to build geographically the large data centers are cheaper than small data centers. Content delivery and interactive gaming are time-critical services

in response of Geo- diversity. For example, Valancius et al. [18] studied the feasibility of hosting video-streaming services using application gateways. Another related research work is on using voluntary resources (i.e. resources given by users) for hosting cloud applications. Clouds built for more suitable for non-profit applications such as scientific computing and it is a mixture of voluntary and dedicated resources are much cheaper to operate. In this architecture specifies the design challenges such frequent churn events and managing heterogeneous resources.

d) Software Licensing

Existing commercial software licenses usually control on which computer the software can run. Users can pay an annual maintenance fee and initially payment for the software.

For Cloud Computing applications, this existing commercial licensing approach for software is not fine and many cloud computing providers are relying on open source software [19] . The primary solution for commercial software companies is to better fit Cloud Computing by change their licensing structure.

The challenge is software companies to sell products into Cloud Computing by support sales services . Pay- as-you-go seems may not fit with the target analysis used to evaluate usefulness, which is based on single purchases. The solution to this challenge is cloud providers to offer at discount new plans for bulk use.

e) Client incomprehension

We're probably not in the days where people used to think that clouds were just big clusters of servers, but that doesn't mean we're free of ignorant. We are aware of the fact that the cloud is moving forward.

There are many misunderstandings about how private and public clouds work together, how virtualization and cloud computing overlap and also how to move from one kind of infrastructure to another and so on.

A good way to clear these is to present users / customers with real-time examples of what is possible and why. Which clears their understanding on actual work that's been done and not just hypothetical's where they're left to fill in the blanks themselves

f) Ad-hoc standards as the only real standards

Amazon EC2 is the biggest example of this. As convenient as it is to develop for the cloud using EC2 as one of the most common types of deployments, it's also something to be cautious. On the optimistic side, they bootstrap adoption. That is look how quickly a whole culture of cloud computing has sprung up around EC2. On the negative side, it means that much less space for innovators to create something open, to let things break away from the ad-hoc standards and can be adopted on their own.

VII. Conclusion

Cloud Computing emerged as a major technology to provide services over the Internet in easy and efficient way. The main reason for possible success of cloud computing and vast interest from organizations throughout the world is due to the broad category of services provided with cloud. The cloud computing is making the utility computing into a reality. The current technology does not provide all the requirements needed by the cloud computing. There are many challenges to be addressed by the researchers for making cloud computing work well in reality. Some of the challenges like security issues and Data issues are very much required for the customers to use the services provided by the cloud. Similarly challenges like Security, performance issues and other issues like energy management etc are important for the service providers to improve the services. In this paper we have identified the challenges in terms of security issues, data challenges, performance challenges and other design challenges. We have provided an insight into the possible solutions to these problems even though lot of work is needed to be done in this regard.

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