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Cloud Computing – A Study on Research Issues, Architecture and Challenges

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Abstract – Cloud computing is becoming an increasingly popular enterprise model in which computing resources are made available on-demand to the user as needed. The unique value proposition of cloud computing creates new opportunities to align IT and business goals. Cloud computing use the internet technologies for delivery of IT-Enabled capabilities 'as a service' to any needed 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. In this paper I provide a comprehensive study on the motivation factors of adopting cloud computing, review the several cloud deployment and service models. "Cloud" computing – a relatively recent term, builds on decades of research in virtualization, distributed computing, utility computing, and more recently networking, web and software services. However, security and privacy issues present a strong barrier for users to adapt into cloud computing systems. In this paper, we investigate several cloud computing system providers about their concerns on security and privacy issues.

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INTRODUCTION

Distributed computing is turning into an inexorably famous venture show in which registering assets are made accessible on-request to the client as required. The one of a kind incentive of distributed computing makes new chances to adjust IT and business objectives. Distributed computing utilize the web advancements for conveyance of IT-Enabled abilities 'as a benefit' to any required clients i.e. through distributed computing we can get to anything that we need from anyplace to any PC without agonizing over anything like about their stockpiling, cost, administration et cetera. In this paper I give a thorough report on the inspiration elements of receiving distributed computing, audit the few cloud arrangement and benefit models. It additionally investigate certain advantages of distributed computing over conventional IT benefit condition including versatility, adaptability, lessened capital and higher asset usage are considered as reception purposes behind cloud processing condition. I likewise incorporate security, protection, and web reliance and accessibility as shirking issues. The later incorporates vertical versatility as specialized test in cloud condition.

An Envisioning the computing utility based on the service provisioning model, where resources are readily available on demand, has led to contemporary computing paradigms that have emerged in the last decade, exploiting technological advances in networked computing environments e.g. GRID computing, peer to peer computing and more recently cloud computing. Figure-1 shows the result as Cloud Computing from Evolution process of various computing technologies. Cloud computing is a new infrastructure deployment environment that delivers on the promise of supporting on-demand services like computation, software and data access in a flexible manner by scheduling bandwidth, storage and compute resources on the fly without required end-user knowledge of physical location and system configuration that delivers the service. , Cloud computing is 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. Cloud Computing is virtualized compute power and storage delivered via platform-agnostic infrastructures of abstracted hardware and software accessed over the Internet. These shared, on-demand IT resources, are created and disposed of efficiently, are dynamically scalable through a variety of programmatic interfaces and are billed variably based on measurable usage. In a traditional hosted environment, resources are allocated based on peak load requirements. In cloud computing they can be dynamically allocated.

Cloud computing is a complete new technology. It is the development of parallel computing, distributed computing grid computing, and is the combination and evolution of Virtualization, Utility computing, Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS). Cloud is a metaphor to describe web as a space where computing has been pre-installed and exist as a service; data, operating systems, applications, storage and processing power exist on the web ready to be shared. To users, cloud computing is a Pay-per-Use-On-Demand mode that can conveniently access shared IT resources through the Internet. Where the IT resources include network, server, storage, application, service and so on and they can be deployed with much quick and easy manner and least management and also interactions with service providers. Cloud computing can much improve the availability of IT resources and owns many advantages over other computing techniques. Users can use the IT infrastructure with Pay-per-Use-On-Demand mode; this would benefit and save the cost to buy the physical resources that may be vacant.

Cloud Computing

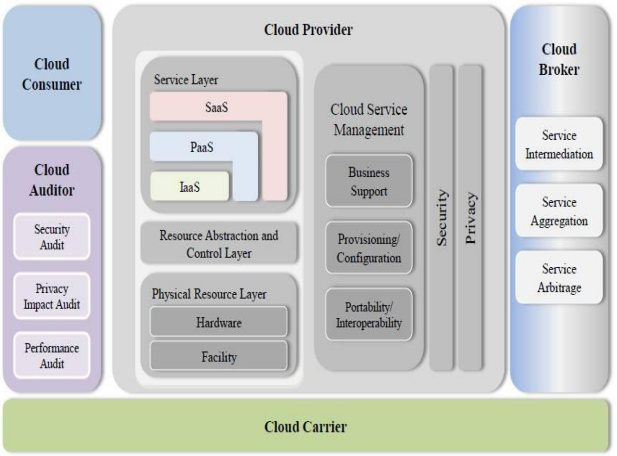
A key differentiating element of a successful information technology (IT) is its ability to become a true, valuable, and economical contributor to cyber infrastructure (Zhang et. al., 2010). “Cloud” computing embraces cyber infrastructure, and builds upon decades of research in virtualization, distributed computing, “grid computing”, utility computing, and, more recently, networking, web and software services. It implies a service oriented architecture, reduced information technology overhead for the end-user, greater flexibility, reduced total cost of ownership, ondem and services and many other things.

Nowadays the Cloud computing comes into fashion due to the need to build complex IT infrastructures. Users have to manage various software installations, configuration and updates. Computing resources and other hardware are prone to be outdated very soon. Therefore outsourcing computing platforms is a smart solution for users to handle complex IT infrastructures.

At the current stage, the Cloud computing is still evolving and there exists no widely accepted definition. Based on our experience, we propose an early definition of Cloud computing as follows: A computing Cloud is a set of network enabled services, providing scalable, QoS guaranteed, normally personalized, inexpensive computing platforms on demand, which could be accessed in a simple and pervasive way.

ARCHITECTURAL COMPONENTS

Cloud service models are commonly divided into SaaS, PaaS, and IaaS that exhibited by a given cloud infrastructure. It’s helpful to add more structure to the service model stacks: Fig. shows a cloud reference architecture (Crnkovic and Larsson, 2002). that makes the most important security-relevant cloud components explicit and provides an abstract overview of cloud computing for security issue analysis.



A. Cloud Service Model

Cloud computing is a delivery of computing where massively scalable IT-related capabilities are provided —as a service across the internet to numerous external clients. This term effectively reflects the different facets of the Cloud Computing paradigm which can be found at different infrastructure levels. Cloud Computing is broadly classified into three services: —IaaS", "PaaS" and "SaaS”. Cloud Computing have some different utility services.

- **Software as a Service (SaaS)**

Cloud consumers release their applications in a hosting environment, which can be accessed through networks from various clients (e.g. Web browser, PDA, etc.) by application users. Cloud consumers do not have control over the cloud infrastructure that often employs multi-tenancy system architecture, namely, different cloud consumers' applications are organized in a single logical environment in the SaaS cloud to achieve economies of scale and optimization in terms of speed, security, availability, disaster recovery and maintenance. Examples of SaaS include SalesForce.com, Google Mail, Google Docs, and so forth.

- **Platform as a Service (PaaS)**

PaaS is a development platform supporting the full “Software Lifecycle” which allows cloud consumers to develop cloud services and applications (e.g. SaaS) directly on the PaaS cloud. Hence, the difference between SaaS and PaaS is that SaaS only hosts completed cloud applications whereas PaaS offers a development platform that hosts both completed and in-progress cloud applications. This requires PaaS, in addition to supporting application hosting environment, to possess development

infrastructure including programming environment, tools, configuration management, and so forth. An example of PaaS is Google App Engine.

- **Infrastructure as a Service (IaaS)**

Cloud consumers directly use IT infrastructures (processing, storage, networks and other fundamental computing resources) provided in the IaaS cloud. Virtualization is extensively used in IaaS cloud in order to integrate/decompose physical resources in an ad-hoc manner to meet growing or shrinking resource demand from cloud consumers. The basic strategy of virtualization is to set up independent virtual machines (VM) that are isolated from both the underlying hardware and other VMs. Notice that this strategy is different from the multi-tenancy model, which aims to transform the application software architecture so that multiple instances (from multiple cloud consumers) can run on a single application (i.e. the same logic machine). An example of IaaS is Amazon's EC2.

- **Data as a Service (DaaS)**

The delivery of virtualized storage on demand becomes a separate Cloud service - data storage service. Notice that DaaS could be seen as a special type IaaS. The motivation is that on-premise enterprise database systems are often tied in a prohibitive upfront cost in dedicated server, software license, post-delivery services and in-house IT maintenance. DaaS allows consumers to pay for what they are actually using rather than the site license for the entire database. In addition to traditional storage interfaces such as RDBMS and file systems, some DaaS offerings provide table-style abstractions that are designed to scale out to store and retrieve a huge amount of data within a very compressed timeframe, often too large, too expensive or too slow for most commercial RDBMS to cope with. Examples of this kind of DaaS include Amazon S3, Google BigTable, and Apache HBase, etc

B. Cloud Deployment Model

There are four primary cloud computing deployment models which are available to service consumer as shown in fig-.

1) Public cloud/external cloud: This model allows cloud environment as openly or publically accessible. Public cloud is off premise in which various enterprises can be used to deliver the services to users by taking it from third party.

2) Private cloud/internal cloud: This model referred to on-premise cloud which is managed or owned by an organization to provide the high level control over cloud services and infrastructure. In other words private cloud is build specifically to provide the services within an organization for maintaining the security and privacy.

3) Hybrid cloud/virtual private cloud model: This model compromised both private and public cloud models where cloud computing environment is hosted and managed by third party (off-premise) but some dedicated resources are privately used only by an organization.

4) Community model: It allows the cloud computing environment which is shared or managed by number of related organizations.

APPLICATIONS

There are a few applications of cloud computing (Zhang et. al., 2010). as follows:

1) Cloud computing provides dependable and secure data storage center.

2) Cloud computing can realize data sharing between different equipments.

3) The cloud provides nearly infinite possibility for users to use the internet.

4) Cloud computing does not need high quality equipment for the user and it is easy to use.

ISSUES IN CLOUD COMPUTING

More and more information on individuals and companies is placed in the cloud; concerns are beginning to grow about just how safe an environment it is? Issues of cloud computing (Yang and Chen, 2010). can summarize as follows:

A. Privacy C

Cloud computing utilizes the virtual computing technology, users' personal data may be scattered in various virtual data centers rather than stay in the same physical location, users may leak hidden information when they are accessed cloud computing services. Attackers can analyze the critical task depend on the computing task submitted by the users.

B. Reliability

The cloud servers also experience downtimes and slowdowns as our local server.

C. Legal Issues

Worries stick with safety measures and confidentiality of individual all the way through legislative levels.

D. Compliance

Numerous regulations pertain to the storage and use of data requires regular reporting and audit trails. In addition to the requirements to which customers are subject, the data centers maintained by cloud providers may also be subject to compliance requirements.

E. Freedom

Cloud computing does not allow users to physically possess the storage of the data, leaving the data storage and control in the hands of cloud providers.

F. Long-

Term Viability You should be sure that the data you put into the cloud will never become invalid even your cloud computing provider go broke or get acquired and swallowed up by a larger company.

G. Issues in Cloud Interoperability

1) Intermediary Layer

A number of recent works address the interoperability issue by providing an intermediary layer between the cloud consumers and the cloud-specific resources (e.g. VM).

2) Open Standard

Standardization appears to be a good solution to address the interoperability issue. However, as cloud computing just starts to take off, the interoperability problem has not appeared on the pressing agenda of major industry cloud vendors.

3) Open API

SUN has recently launched the Sun Open Cloud Platform (Bulkeley, 2007). under the Creative Commons license. A major contribution of this platform is the proposed (in-progress) the cloud API. It defines a set of clear and easy-to-understand REST full Web services interfaces, through which cloud consumers are able to create and manage cloud resources, including compute, storage, and networking components in a unified way.

4) SaaS and PaaS Interoperability

While the aforementioned solutions generally tackle with IaaS interoperability problems, SaaS interoperability often involves different application domains such as ERP, CRM, etc. A group of experts in the field of data mining raises the issue of establishing a data mining standard on the cloud, with a particular focus on “the practical use of statistical algorithms, reliable production deployment of models and the integration of predictive analytics” across different data mining-based SaaS clouds.

CHALLENGES ON CLOUD ADOPTION PERSPECTIVE

Cloud systems are not just another form of resource provisioning infrastructure and in fact, have multiple opportunities from the principles for cloud infrastructures that will enable further types of applications, reduced development and provisioning time of different services. Cloud computing has particular characteristics that distinguish it from classical resource and service provisioning environments.

- Infinitely (more or less) Scalable
- Cost saving/less capital expenditure
- Higher resource Utilization
- Business agility Disaster recovery and Back up
- Device and Location Independence

As we know, cloud computing has various motivating factors according to the perspective of adoption but there is still long way for cloud computing to prove itself according to the organization’s trust level. There are various reasons that warns us for the adoption of cloud computing.

Security

Security issue has played the most important role in hindering Cloud computing acceptance. Various security issues, possible in cloud computing are: availability, integrity, confidentiality, data access, data segregation, privacy, recovery, accountability, multi-tenancy issues and so on. Solution to various cloud security issues vary through cryptography, particularly public key infrastructure (PKI),use of multiple cloud providers, standardization of APIs, improving virtual machines support and legal support.

Difficult to migrate

It’s not very easy to move the applications from an enterprise to cloud computing environment or even within different cloud computing platforms because different cloud providers support different application architectures which are also dissimilar from enterprise application architectures.

Internet dependency – performance and availability

Cloud computing services rely fully on the availability, speed, quality and performance of internet as it works as carrier in between consumer and service provider.

DOWNTIME AND SERVICE LEVEL

In business applications, downtime is common concern because every minute of downtime is minute in which important business application can't be performed which degrades the performance of organization as well reputation also.. Scalability is the best solution to increasing and maintaining application performance in cloud computing environments. But one of the main technological challenge of cloud environment is vertical scalability (Scale up) because in cloud environment elastic scalability is not only currently restricted to horizontal scaling (Scale out), but also inefficient as it tends to resource over usage due to limited scale down capabilities and full replication of instances rather than only of essential segments. Horizontal scaling is scaling through the addition of more machines or devices to the computing platform to handle the increased demand. Vertical Scaling, on the other hand, ability to scale the size of a server i.e. in this scaling the size of server is scaled either by resizing the server or by replacing that server to bigger one.

CONCLUSIONS

Cloud computing have several benefits over traditional (non- cloud) environment and have capability to handle most sudden, temporary peaks in application demand on cloud infrastructures. Virtualization technology provides good support to achieve aim of cloud computing like higher resource utilization, elasticity, reducing IT cost or capital expenditure to handle temporary loads as well as cloud computing have various flexible service and deployment models which is also one of the main issue of adopting this computing paradigm. Cloud Computing initiatives could affect the enterprises within two to three years as it has the potential to significantly change IT. "Cloud" computing builds on decades of research in virtualization, distributed computing, utility computing, and, more recently, networking, web and software services. It implies a service-oriented architecture, reduced information technology overhead for the end-user, great flexibility, reduced total cost of ownership, ondemand services and many other things.

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