Cloud Computing As a Service over Internet

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Abstract- **CLOUD COMPUTING IS THE LATEST BUZZWORD IN THE WORLD OF COMPUTING AND INTERNET TECHNOLOGIES. CLOUD COMPUTING IS BLEND OF INTERNET (CLOUD) BASED DEVELOPMENT AND USE OF COMPUTER TECHNOLOGY. IT IS A PARADIGM SHIFT WHEREBY DETAILS ARE ABSTRACTED FROM THE USERS WHO NO LONGER NEED KNOWLEDGE OF, EXPERTISE IN, OR CONTROL OVER THE TECHNOLOGY INFRASTRUCTURE "IN THE CLOUD" THAT SUPPORTS THEM. IT TYPICALLY INVOLVES THE PROVISION OF DYNAMICALLY SCALABLE AND OFTEN VIRTUALIZED RESOURCES AS A SERVICE OVER THE INTERNET.**

Keywords- **CLOUD COMPUTING, ON DEMAND SERVICE, BUSINESS MODELS, PARADIGM SHIFT, A RAY OF HOPE**

I. INTRODUCTION

Cloud computing, born in the e-business context, and grid computing, originated in the e-science context, are two different but similar paradigms for managing large sets of distributed computing resources[6]. With most of us living our second lives in virtual worlds, chatting with virtual people or even flying to thousands of exciting virtual 3D locations, the 'cloud' definitely looks like the way to the future [3].Cloud computing is an evolution from Grid computing in 1990 towards more dynamic, secure computing environment to drive business transformations. Even though, Cloud computing evolved from utility computing and transformed from Grid computing but Cloud and Grid computing are distinct and mandate different architectures. Apart from the technical definition of Cloud computing in simple terms, it defines as a set of pooled computing resources, delivered over the web and powered by software. Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services[4].It the convergence and evolution of several concepts such as virtualization, distributed application design, grid, and enterprise IT management to enable a more flexible approach for deploying and scaling applications. Cloud computing is often provided as a service over the internet, typically in the form of Infrastructure as a service (IAAS), Platform as a service (PAAS), or Software as a service (SAAS) [1]. It is providing services on virtual machines allocated on top of a large physical machine pool. Whereas for a normal internet users and technology consumers, cloud computing may be interpreted as any online activity that can be performed from various electronic devices including mobile and virtualized. Few of the most popular cloud computing activities among users are the instances of the use of e-mail services such as Yahoo or Gmail, storage of photos through website like Flickr or Picasa, storage of videos through video online channels like Youtube, use of software programs and social networks such as Myspace and Facebook and alike. Even though the Cloud computing have evoke much interest to the scientific as well as business community over last two years because of huge potential for substantiating other technological advances while presenting a superior utilitarian advantage over the currently under-utilized resources deployed at data centres.

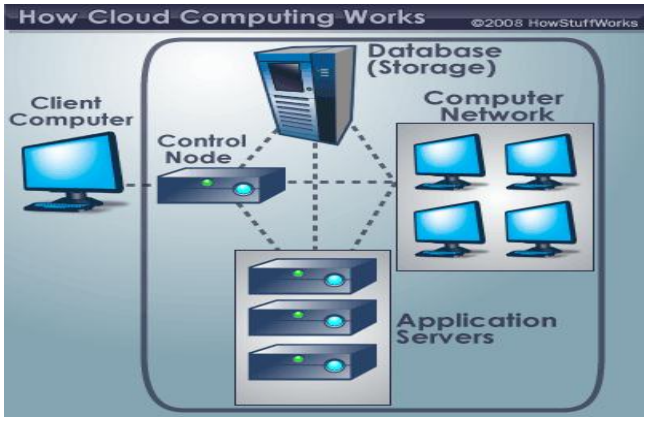
II. OVERVIEW OF CLOUD COMPUTING

With the advancement of modern society, basic essential services are commonly provided such that everyone can easily obtain access to them. Today, utility services, such as water, electricity, gas, and telephony are deemed necessary for fulfilling daily life routines. These utility services are accessed so frequently that they need to be available whenever the consumer requires them at any time. Consumers are then able to pay service providers based on their usage of these utility services[7]. People want to get to their e-mail instantly, without waiting for their computers to boot and browsers to start up. As Google says, they want their computer to be extremely fast, their data to be accessible anywhere they go and free from 'back-up' worries. More importantly, they don't want to spend hours configuring their computers to every new hardware or software updates. This need gave rise to the birth of 'cloud' phenomenon [3]. In this global economic meltdown and the highly competitive market Sharing of resources is always seemed to bring some benefits when it comes to

optimum utilization of existing resources or services thereby cutting its operational cost. So it only makes sense that sharing computing resources and computer pooling would do the same and in fact it does [1]. Moving towards Cloud Computing will not only help companies save money on their balance sheets but it will also allow small and startup companies to help minimize the investment in the IT infrastructure and its operational cost there by going green and save the environment (By means of less heat emission). It promises real costs savings and agility to the customers of the organization as the company can rapidly deploy applications where the underlying technology components can expand and contract as per the natural flow of the business life cycle. Traditionally, once an application was deployed in a process it used to be bound to a specific infrastructure, until the infrastructure was upgraded that resulted low efficiency, utilization, and flexibility. Cloud enablers, such as virtualization and grid computing, allow applications to be dynamically deployed onto the most suitable infrastructure at run time.Virtualization allows abstraction and isolation of lower level functionalities and underlying hardware. This enables portability of higher level functions and sharing and/or aggregation of the physical resources[8].This elastic aspect of cloud computing allows applications to scale and grow without needing infrastructure upgrades. Thus the convergence and evolution of several concepts from virtualization, distributed application design, grid, and enterprise IT management to enable a more flexible approach for deploying and scaling applications.

In this global economic meltdown and the highly competitive market demands that IT departments and infrastructure providers are always under increasing pressure to facilitate computing infrastructure at the lowest possible cost, thus the concepts of resource pooling, virtualization, dynamic provisioning, utility and commodity computing brings a leveraged to create a public or private cloud that meets these needs. With the advancement of the technology and high end products world class data centers are now being formed that can provide this Infrastructure-as-a-Service (IAAS) in a very efficient manner [1]. Thus the company can decide to develop their own applications that to run on their own internal private clouds, or leverage from Software as a Service (SaaS) applications that generally run on public clouds. The advantages of SaaS to both end users and service providers are well understood. Service providers enjoy greatly simplified software installation and maintenance and centralized control over versioning; end users can access the service "anytime, anywhere", share data and collaborate more easily, and keep their data stored safely in the infrastructure[4].

The public cloud concept allows customers to develop and deploy applications with tremendous speed without the procurement of costly IT equipments thereby allowing companies to shift traditional Capital Expenditures into their Operating Expenditure budgets. But the concerns over security, regulatory compliance, control over Quality of Service (QoS), vendor lock-in, and long-term costs, many larger enterprises having the economies of scale and strong IT competency, will prefer to build own internal private clouds. These private clouds can provide the same cost and suppleness benefits as public clouds, while extenuating its concerns about security, compliance, Quality of Service, lock-in, and Total Cost of Ownership [1]. Hybrid Cloud which is an integration and amalgamation of services across both the public and private cloud is an emerging area of interest in near future.



Source http://math.hws.edu/~ak9941/cs271/Clouds/

III. TYPES OF CLOUD

A. Private Clouds

In this cloud, the infrastructure for implementing the cloud is controlled completely by the enterprise and are implemented in the enterprise's data center and managed by internal resources. Here it maintains all corporate data in resources under the control of the legal and contractual umbrella of the enterprise. This eliminates the regulatory, legal and security concerns associated with information being processed on third party computing resources. But private clouds require Capital Expenditure and Operational Expenditure as well as highly skilled manpower to ensure that business services process can be met [1].

Generally larger enterprises find it more economical to develop future state architectures internally to deliver the benefits of cloud computing for internal processes and to its subscribers of the services. This model is ideal for enterprises that are organized with a shared services IT infrastructure and is generally preferred among C level executives who require that the corporate sensitive data's are securely located in known locations and by trusted staff [1]. The private cloud can also be used by existing legacy IT departments to dramatically reduce their costs and as an opportunity to shift from a cost center to a value center in the eyes of the business.

B. Public Clouds

In this type external organizations provide the infrastructure and management required to implement the cloud. Public clouds radically simplify accomplishment and are typically billed based on usage like the utility computing. This approach transfers the cost of computing from a capital expenditure to an operational expense and can swiftly scale to meet the requirements as per the need of the organization. Short term applications or applications with burst resource requirements typically benefits from the public cloud's ability to ratchet up resources when needed and then scale them back when it's not needed [1]. In a private cloud, the company needs to have provision for the worst case across all the applications that share the infrastructure which results in wasted resources when there is under utilization of the resources at the lean period.

Public clouds have the major disadvantage of hosting the sensitive data in an offsite organization outside the legal and regulatory umbrella of the organization. In fact as most public clouds leverage a worldwide network of data centers, it is difficult to document the physical location of data at any particular moment which result in potential regulatory compliance issues that preclude the use of public clouds for certain organizations or business applications. However, all the public cloud based applications can't provide the necessary flexibility and functionality needed by specific business users and customers require the ability to take preferred functionality from one cloud application and combine it with another, creating a cloud based component application [1]. This is still an emerging area of development with some companies providing integration of a wide range of cloud based applications. These might steer many customers who may decide that the private cloud offers more flexibility and thus develop new applications themselves.

C. Hybrid Clouds

To congregate the benefits of both approaches of cloud computing, newer execution models have been developed to combine public and private clouds into a unified solution. In this hybrid cloud applications with significant legal, regulatory or service level concerns for data can be directed to a private cloud and other applications with less stringent regulatory or service level requirements can leverage a public cloud infrastructure [1].

Implementation of a hybrid model requires additional coordination between the private and public service management system which typically involves a federated policy management tool, seamless hybrid integration, federated security, information asset man.

IV. DISTINCT FEATURES OF CLOUD COMPUTING

Cloud computing systems fall into one of five layers: applications, software environments, software infrastructure, software kernel, and hardware[5]. The industry appeal of Cloud Computing is certainly a two-way street. Cloud Computing is not hosting but Service Level Agreements, Security and Disaster Recovery are chief considerations for any 3rd party provider of computational services apart from application up-time, service, delivery and cost. We can access the 'cloud' from anywhere, whether it is Personal Computer, Mac, console, phone or even through television. All we need is availability of Internet connection [3]. Consumers don't own the hardware they are using but they merely access or rent it, hence they can forego the high capital expenditure of purchasing infrastructure and maintaining it with business-focused application delivery. The various unique features that make cloud computing distinct are as follows [1].

A. User-CENTRIC Interfaces

Cloud services are accessed with simple and pervasive methods that adopt the concept of utility computing where users obtain and employ computing platforms in computing Clouds as easily as they access a traditional public utility. The simplicity in a cloud computing are that

- The interfaces do not force users to change their working habits and environments.
- The client software required to be installed locally is trivial
- Interfaces are location independent and can be accessed by Web services framework

B. On-Demand Service Provisioning

Clouds provide resources and services for users on demand where user can customize and personalize their computing environments later on, for example, software installation, network configuration, as users usually own administrative privileges.

C. QoS Guaranteed Offer

Computing environments provided by the Cloud computing can guarantee QoS for users by processing Service Level Agreement (SLA) with users – a negotiation on the levels of availability, serviceability, performance, operation, or other attributes of the service such as billing and even incorporating penalties in the case of the SLA shortcomings.

D. Autonomous System

Cloud is an autonomous system and it is managed transparently to users where hardware, software and data inside clouds can be automatically reconfigured, orchestrated and consolidated to present a single platform image, finally rendered to users.

E. Scalability and Flexibility

The scalability and flexibility are the most important features that drive the emergence of the Cloud computing where Cloud services and computing platforms could be scaled across various concerns, such as geographical locations, hardware performance and software configurations. The computing platform in the Cloud computing are flexible to adapt to various requirements of a potentially large number of users.

V. Impact On Traditional Business Models

In current business environment, organisations are focused on controlling costs, streamlining busiens processes, and optimising efficiency. They also need to be able to captialise on opportunities that arise even amid the financial downturn. The reality today is most companies will manage a hybrid business environment comprising both traditional infrastructure and the cloud[2].Intel, Microsoft, Google, Cisco and HP have recognized the challenge that the cloud computing paradigm shift poses to their traditional business models and some have already begun making strategic shifts. As far as Google and Amazon type of companies are concerned, they are well situated to prosper in this new world. Such companies are already equipped with the expertise required to run large data centers hosting applications on scalable and sometimes virtualized resources platform providing service to a large number of independently administered customers, and thus can evolve to become software utility type of companies [1].

The merger of networks and computing platforms implied by could computing will affect the computing hardware vendors like Intel, Cisco, HP, Dell, EMC. Proactive approach of Cisco has already started a new business division. This will combine networks, storage and computing.

Intel is also facing the same challenge. Large software utility customers, who have sophisticated in-house engineering, are less likely to be impacted by Intel's brand power, i.e., "Inside Intel" brand. The popularity of open source software is also one of the reasons behind the migration of large data centers from Wintel platforms. More stable, flexible and cost effective features of open source software are the major reasons behind the migration [1]. To face this challenge Intel is responding by focusing on making multiple-core processor chips to achieve scalable performance and offers efficient utilization of power.

Microsoft has a bit of a challenge in responding to this paradigm shift. Windows is not the leading software product when it comes to working on virtualized resources or multi-core processor chips. Microsoft is challenged by the popularity of open source platform in data centres [1]. Microsoft is also challenged by Google, which seems intent on developing an independent platform for cloud computing.

VI. Architecture Implications And Elements

In any enterprise while migrating to cloud computing environment irrespective of private or public cloud it involves significant changes to the role of an IT department, supplier relationships, and the way applications are developed and used. From the perspective of an IT department and its suppliers, there are a number of key areas to consider, including composite applications, standards, and external and internal clouds, there are a number of architectural implications & principles that should be observed.

A. Business Architecture

Cloud computing offers a unique control in allocating resources dynamically to meet the changing needs of any business but it is effective only when the businesses service level objectives have been clearly articulated and guide the cloud's enterprise management layer while application performance metrics and SLAs should be carefully documented and monitored for an effective cloud deployment. To maximize the distributed capabilities afforded by clouds, business processes should identify areas where asynchronous or parallel processes can be used. The Business Architecture is guided by the following key elements

- Business Alignment & Cost Optimization
- Compliance with Laws & Regulations
- Business Agility
- Minimize Cost

B. Application Architecture

Application services ought to abstract resource allocation and avoid the rigid requisite of its resources to invokers of the service while various dependencies on static references to infrastructure such as storage, servers, network resources as well as compactly coupled interfaces to dedicated systems, should be avoided. For achieving benefit of the cloud's scalability capabilities, applications should take advantage of distributed application design and utilize multi-threading as per as possible. The designed applications should influence distributed locking, GUID generation, and integration layers to provide the greatest flexibility in deploying on a cloud. The Application Architecture is guided by the following key elements

- Technology Independence & Adherence to Standards
- Common Development Methodology
- Loosely Coupled Interfaces

C. Information Architecture

As cloud computing offers the potential to utilize information anywhere in the cloud it increases the complexity related with meeting legal and regulatory requirements for sensitive information. So by employing a secure Information Asset Management system will provide the necessary controls to ensure protection of sensitive information that meets compliance requirements. This is specifically essential when

considering the public or hybrid clouds as information may leave the confines of the data center, which might violate certain legal and regulatory requirements for some enterprises [1]. The Information Architecture is guided by the following key elements

- Implement Information Lifecycle Management
- Regulatory & Legal Compliance
- Enforce Data Privacy

D. Technology Architecture

The highly distributed nature of cloud computing requires a more robust security management infrastructure as Service Oriented Architectures (SOA) provides the most effective means of leveraging the capabilities of cloud computing. SOAs distributed nature, service encapsulation; defined service level objectives, virtualized interfaces, and adherence to open standards align with Cloud's architectural requirements [1]. Implementing federated identity hubs and defined communication zones are typically required for cloud deployments to control access across multiple cloud nodes--especially when those nodes exist outside the enterprise. Cloud infrastructures simplify the deployment of grid application servers which offer improved scalability and disaster recovery.

The Technology Architecture is guided by the following key elements

- Control Technical Diversity
- Adherence to Standards
- Scale Capacity & Availability to satisfy Business Objectives
- Virtualized dependencies to hardware and software
- Unified Security Infrastructure

VII. Effect On Indian Software Industry

According to a conducted by HP, 48 per cent of Asia-Pacific respondents view the current economic climate as an opportunity to restructure their technology environments for the future. These organisations understand that by deploying a shrewd technology strategy they can come out of the economic downturn ahead of competitors. Executives from across the region indicate that they are either planning or considering the following projects in the coming future. Server and storage consolidation (62%); virtualisation (58%), Application modernisation or consolidation (49%) and automation (42%) [2].

Also there is a motivation to reduce costs including saving energy bills among all enterprise and large mid-market customers in India. The virtualisation scenario was encouraging and enterprises move from just testing the concept to actually deploying it.

Cloud computing represents a paradigm shift in the way IT is consumed and provided by vendors to customers. In general, cloud computing customers do not own the physical infrastructure, instead avoiding capital expenditure by renting usage from a third-party provider. They consume resources as a service and pay only for resources that they use. Consumption is usually billed on a utility (e.g., resources consumed, like electricity) or subscription (e.g., time-based, like a newspaper) basis with little or no upfront cost. According to Nicholas Carr, the cloud computing paradigm shift is similar to the displacement of electricity generators by electricity grid early in the 20th century. He argues that this would result in standardization and commoditization of software. Clearly, this is not likely to be good news for Indian software industry [1].

The question we should ask is if Indian software industry will inevitably be a road kill as the paradigm shifts, or is there a silver lining? Indian software industry has been recognized worldwide as a big success story of India. The industry has grown rapidly, starting from the base of $100 million revenue earned collectively in 1990 to expecting $54 billion in revenue in the future [1]. The business model on which the industry has hitherto relied is outsourcing of software development by enterprises, mainly from the US. Many high-paying jobs will be lost and the shining image of India will be dulled if the shift to cloud computing ends up affecting the growth of this industry.

The shift to cloud computing will affect Indian software industry in two different ways. Indian software industry currently focuses on getting contracts from private and public enterprises that outsource their software development work in order to reduce costs. If cloud computing becomes popular, those customers would disappear [1]. Instead we will see emergence of few large software-as-utility providers that will be providing computing services to enterprise customers. Think of Google and Amazons as the types of companies that would become software utility companies.

Indian software companies have no experience in providing services to such customers. Nor do we know if these customers would want to outsource any software development work to offshore centers. Another potentially bigger problem that cloud computing may create is its potential for standardization and consequently less customisation of software [1]. This would mean that there is less of the type of work available for which Indian software companies have specialized.

VIII. The Role Of Indian Government: Limitations Of Indian Companies

Indian government should also formulate such policies that encourage formation of large data centers in India. Currently no one in India is running a data centers of the type and scale that Goolge and Amazon have [1]. Primary obstacle may be the high cost of power and the lack of network in metro locations. The cost of labors and real estates are not so high

but good fiber connections are needed between all the metro locations. Government and companies can cooperate in taking part on going international work that may act to prevent transfer of data across national boundaries for security reasons. Small and medium size software companies can encounter the situation jointly. Initially it may produce slower results [1]. But if we wait to take some preemptive measures, software industry, may suffer a fate similar to that of a lobster being gently boiled to perfection.

Use of any technology or techniques has its own pros and cons. Enterprise should study the various issues as per the requirements of the specific organization.

A. Pros of Cloud computing

- Reduced Cost

  Cloud technology is paid incrementally as one pay only for what one needs or use thereby saving organizations expenses in the short run. Money saved can be used for other important resources.

- Increased Storage

  Organizations can store more data compared to on the private computer systems.

- Highly Automated

  IT support personals need not to keep software up to date as the maintenance is service provider responsibility on the cloud.

- More Mobility

  Employees can access information wherever they are giving them full mobility rather than having to remain at their desks.

- Allows IT to Shift Focus

  As it is no longer having to worry about constant server updates and other computing issues, organizations will be free to concentrate on innovation.

B. Cons of Cloud computing

- Security
  There is no security compliance standard.

- Reliance on 3rd Party
  There is no direct control over own data.

- Cost of transition
  Uncertainty of the transition to move from the existing architecture of own data center to the architecture of the cloud.

- Uncertainty of benefits
  Uncertainty of any scalable long term benefits

IX. A Ray Of Hope

If we think and act strategically before the crisis hits, this paradigm shift instead of being a disaster may end up being a new opportunity to Indian software companies. If new technology of paradigm shift is to be taken with perfect strategy, it will become an opportunity to Indian software companies [1]. Several companies like Infosys, TCS, Tech Mahindra and Wipro are involved in developing strategies for cloud computing. Incidentally they are making efforts by creating it as more revenue producing source rather than as an existing threat. The companies which understand about the proper and efficient services to be given to the customers surely will be more benefited. There is a need of similar platform to be built up for these companies as Google and Microsoft have already built. Though it is not an easy task but not a hopeless one either [1]. More efforts are needed to develop platforms to migrate stand alone applications to cloud computing. It is indeed that the four major companies like TCS, Infosys, WIPRO and HCL should start a joint venture to develop and deploy this platform. Other strategic option is for those companies to build large data centers to provide proper and timely services to enterprises.

X. Implementing Cloud Computing

A number of models have been developed for deploying a cloud infrastructure in an enterprise. While various competing interests approaching the Cloud, it is in the interest of the consumer of these services to identify specific Cloud as per their requirements [1]. Consumer has to identify the applications and services that lend themselves to a specific model. As we decide on building the cloud, a number of models have been developed for deploying a cloud infrastructure as per the implication of the enterprise.

XI. Future Of Cloud Computing

The preferences of IT owners and regulator shift away from the cost and irregularity of on-premise IT, towards the auditable and highly professional security practices of cloud-service providers. As the understanding of process and governance risk improves Conventional consumers will become more hostile in lowering their cost of both personal and business computing. It will become far more accepting of lightweight client machines running free, open-source operating systems and applications. Companies will prefer to build systems that engage their partners and customers in mutual processes of product and service improvement rather than building only inward-looking systems for in-house analysis of the world outside the company's wall. That means the companies will redefine the "C" in "CRM" as "Community" rather than "Customer" [1]. Developers specifically those in India, China and Brazil will find their most rapidly growing opportunities in their own home markets. They will shift their focus toward building high-value applications for neighbour companies rather than providing low-cost labour to mature markets overseas.

Also, instead of growing at the glacial speed of multi-year upgrade cycles that currently results in most IT sites running legacy versions of unmanageable bloat ware, Software market cycles will rapidly accelerate to Web speed, with multiple releases per year [1]. Worldwide growth in development of demand will increase the importance of high-leverage application frameworks that enable more fast development of higher-quality products.

XII. CONCLUSION

Comparable with the demonstration of the mainframe, the microprocessor, the minicomputer and the Internet, cloud computing is an important stage in the development of IT systems. The Return on Investment can be improved due to cloud computing by means of many advantages that it provides on conventional approached. Its potential effect on business is not just incremental improvement, but disruptive transformation through new operating models and that is what makes it particularly more exciting [1]. No doubt it will become the need of the time as a futuristic computing technology to serve the business and computing needs of the world.

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