Cloud Computing: Future Generation Computing Systems as the 5th Utility

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Abstract—**Cloud computing is the emerging computing platform by providing the computing utilities as service such as platform, software and storage. By the latest advancements in Information and Communications Technology last previous half century, there is an increasing perceived vision that computing is going be the 5th most wanted utility after electricity, telephony, gas, and water. The computing utility is like all other four necessary utilities. It will provide the basic level of computing service that is assumed essential to meet the everyday needs of the general public. In this paper, we define Cloud computing and included the architecture for creating Clouds with market-oriented resource allocation by latest technologies like Virtual Machines. We also provide insights on market-based resource management techniques that encompass both customer-driven service management and computational risk management to sustain Service Level Agreement oriented resource allocation. Finally, we conclude with the need of IT technologies to deliver our current vision of computing.**

Index Terms—**Virtual machines, SLA, CDN system etc.**

I. Introduction

Several computing paradigms have been proposed to deliver the vision of computing as the 5th utility. Mostly this includes Grid computing, cluster computing and now cloud computing. Recent interest in Cloud Computing has been driven by new offerings of computing resources that are attractive due to per-use pricing and elastic scalability, providing a significant advantage over the typical acquisition and deployment of equipment that was previously required. The effect has been a shift to outsourcing of not only equipment setup, but also the ongoing IT administration of the resources as well. The term cloud computing represents the infrastructure as cloud, from which businesses and users are able to access the applications from anywhere in the world on demand. Now the computing world is moving towards developing and providing software as service. Not only software, infrastructure, platform as well as storage also, there is no need to run on the personal computers. The cloud applications are crucial to the core business operations of the consumers. It is necessary that all consumers have guarantees from providers on service delivery. These services are provided by the service level agreements (SLAs) [1] between the consumers and providers. In addition enterprise service consumers with global operation need fast response time, which results in the time saving by distributing workload to the multiple clouds at various locations at same time. There are so many challenges in creating such type of clouds and clouds interconnections. Therefore this paper discusses how the computing transformed as the 5th utility and also the current trends in the area of cloud computing and presents the future enhancements of this technology.

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II. Vision of Cloud Computing & Current Status

Cloud computing has experienced rapid growth in recent years. While mainly the result of rapid technological innovation and increased high-speed broadband offerings, the recent financial crisis has accelerated deployment as companies seek to trim the large overhead costs associated with in-house IT. Cloud computing puts pressure on many different areas of policy, and action is necessary to create the optimal environment for innovation and growth. Broadband deployment, privacy, security, competition policy, and intellectual property reform are just a few areas that must be addressed to foster rapid innovation and adoption of cloud computing. Cloud computing is the latest paradigm which promises reliable services delivered through the next generation data centers that are built on the basis of virtualization, storage and virtual machine technologies. In this users are able to access their applications by a cloud anywhere, anytime across the world easily. The providers give assurance that the cloud infrastructure is very robust, reliable, scalable, dynamic discovery, autonomic to support uniquitous access and available at anytime across the world. In addition the consumers indicate the required service level agreement through quality of service parameters. Among all these computing paradigms the cloud computing appears to be the most promising one to leverage and build on the developments from other computing paradigms such as grid [2] and clusters [3].

III. Implications of Cloud Computing

A cloud typically consists of multiple resources which is distributed and heterogeneous in nature. There are also so many benefits from the adoption and deployment of the clouds such as reliability and scalability .The aim of cloud computing to deliver the more economic solutions to both the parties (i.e. providers and consumers). From economical, we mean that consumers need to pay per their use and providers can capitalize the poorly utilized resources. The aim of providers is to maximize their profit which is a high priority for them. To achieve this cloud provider can no longer continue to deploy traditional system centric resource management architecture that do not provide incentives for them to share their resources. There are four main entities

involved in the architecture for supporting the market oriented resource allocation in the cloud and data centers. These entities are Users and Brokers, SLA resource allocator, Virtual Machines and Physical Machines. The various application areas of cloud computing is shown in the fig.1.

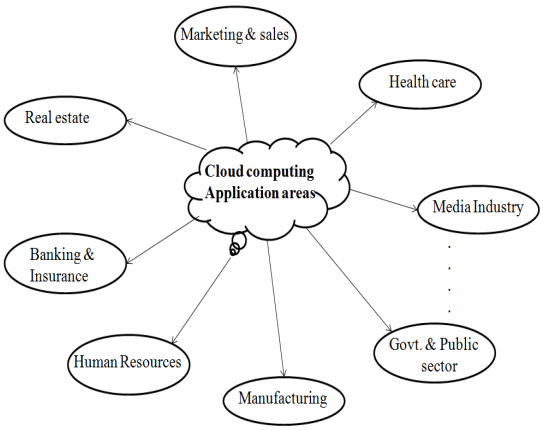

Fig. 1. Various application areas of cloud computing.

IV. Cloud Computing In Marketing And Global Cloud Exchanges

At present the most of the enterprises using cloud services to improve the scalability and quality of their services. The service providers have inflexible pricing which is often limited to flat rates or tariff's depending on the threshold of their usage and consumers are restricted to offerings from a single provider at a time. The standard interfaces are needed for the cloud computing which will enable services to be commoditized which leads to the way of creation of the market infrastructure for the trading services. An example of such a system modeled on real world cloud exchanges and markets as shown in Fig.2 [4] the market directory allows the participants to locate the providers or consumers with the right offers. Auctioneers periodically clear bids and asks received from market participants. The banking system ensures that financial transactions pertaining to agreements between participants are carried out. Brokers perform the same function in such a market as they do in real world markets. A broker can accept requests from many users who have the choice of submitting the requirements to several brokers. Providers, consumers and brokers are bounded together to their requirements and related compensations through the SLA's. The service level agreement specifies the details of the service to be provided in the terms of metrics agreed upon by all the parties and penalties meeting and violating the expectations respectively.

According to the Merill lynch " cloud computing is expected to be a $160-billion addressable market opportunity, including $95-billion in business and productivity applications and another $65-billion in online advertising." The Amazon Elastic Compute Cloud (EC2) [5] provides the virtual computing environment that enables the users to run a Linux based application. The user can create new Amazon Machine Image (AMI) which contains the applications, libraries, data and associated configuration settings or select from the library of available AMI's. Then the user needs to upload the selected AMI's to Amazon Simple Storage Service (S3) charges for any data transfer (i.e. uploaded and downloaded data). Google App Engine [6] supports the application programming interface (API's) for the Google Accounts, URL fetch, email services, image manipulation and data stores. It also allows running the web applications written using the python programming language. It also provides the web based administration control for the user to easily manage his running web applications. Apart from this it plays a vital role in business process management. The role of Business Process Management (BPM) [7] technology will increase significantly with the omnipresence of clouds. First of all, the huge number of services available in the cloud will enable a fast and easy creation of new higher-level services by composing the available services. Secondly, the ubiquitous access to application functionality will result in the formation of networks between partners to create competitive advantage by establishing cross-partner business processes. Cloud technology will significantly ease both, the offering as well as the use of services available. As a consequence, a huge number of services will be available in the cloud and these services will be composed into new services. These services may become available on the cloud again (Composite as a Service) further increasing the number of services in the cloud.

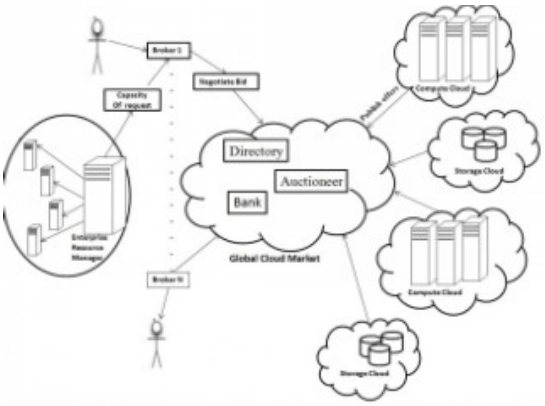

Fig. 2. An example of such a system modeled on real world cloud exchanges and markets.

V. 3rd Party Cloud Services (Content Delivery Networks)

The Content Delivery Network (CDN) [8] provides such as mirror image and Akamai places the web server clusters across the globe to improve the locality and responsiveness of the replicated contents for end users. The services provided by them are priced out to reach for all but the largest enterprise clusters typically requires long contracts and large usage. In this we included an alternative approach to content delivery that leverages existing infrastructure provided by storage cloud provides at a fraction of the cost of traditional CDN providers such as Mirror Image and Akamai. The MetaCDN [9][10] is a system that harnesses global storage cloud resources, creating an integrated network which offers high performance and low cost CDN for content creators. Meta CDN hides the complexity of interacting with multiple

storage providers by intelligently placing and watching the users content onto one or many storage providers based on the QoS, budget, storage and preferences. The utility of this latest approach to deliver the content efficiently and provides high performance in the form of response time, throughput and reliable content delivery for content consumers.

A. CDN in Practice

Several issues are involved in CDN content delivery since there are different decisions related to where to locate surrogate servers, which content to outsource, and which practice to use for (selected content) outsourcing. It is obvious that each decision for these issues results in different costs and constraints for CDN providers.

1) *Surrogate servers placement-* for each CDN infrastructure the selection of best location for each surrogate server is important. The location of surrogate servers is related to important issues in the content delivery process. Determination of the best networks location for CDN surrogate servers is critical for content outsourcing performance and the overall content distribution process. The CDN topology is built in such a way that the client-perceived performance is maximized and the infrastructure's cost is minimized.
2) *Content outsourcing* – in content outsourcing under a CDN infrastructure with a given set of surrogate servers and a selected content for delivery. It is crucial to decide which content outsourcing practice to follow. The cooperative push based is a better method. In this scheme the CDN maintains a mapping between content and surrogate servers and each request is directed to the closest surrogate server or the request is directed to the origin server (i.e. web server).
3) *CDN Pricing* – CDN provides charge their customers –owners of websites according to their traffic. Most of the commercial – oriented websites turn to CDNs to contend with the high traffic problems while providing increased quality and data security for their clients in order to increase their profit and popularity.

B. Storage Clouds and Storage Cloud Used by MetaCDN-

Just like Cloud Computing, Cloud Storage has also been increasing in popularity recently due to many of the same reasons as Cloud Computing. Cloud Storage delivers virtualized storage on demand, over a network based on a request for a given quality of service (QoS) [11]. There is no need to purchase storage or in some cases even provision it before storing data. You only pay for the amount of storage

Your data is actually consuming. Recently the many storage cloud providers that provide internet enabled content storage and delivery capabilities in several continents which offers SLA-backed performance and promises for their services provided by them. These storage providers offer the ability to scale out rapidly and cheaply and meet both flash crowds and anticipated or cyclical increase in demand. The most of them are Nirvanix (SDN) [12], Amazon Simple Storage Service (S3). The MetaCDN service is shown in Fig.3 which is presented to end users in two ways first through an easy web portal and second through RESTful web service. The web portal can be developed by using Java Server Faces (JSF) and Java Enterprise technologies with a clustered MySQL back end to store user accounts and deployments. And also the capabilities, pricing and performance of service providers. By the use of web portal a user can create an account on the MetaCDN system and enter credentials for any cloud storage or ancillary providers. The web portal is most suited for small or ad-hoc deployments and useful for the content creators. It works by integrating each storage providers through connectors and provide an abstraction to hide the complexities from the interfaces. An abstract class, default connector encapsulates the basic functionalities that each provider expected to support. This class must be implemented by all available and future connectors by the help of a common interface. The all basic operation can be performed such as creation, deletion and renaming of folders and files which are stored. An exception has been thrown if any operation does not support the particular service. This assists the MetaCDN system to match a user's deployments to a provider. It provides number of deployment options depending on the user's need such as QoS deployment, deploy content in specific location, maximize coverage, performance and cost optimize deployment. CDNs are still in an early stage of development and their future evolution remains an open issue. It is essential to understand the existing practices involved in a CDN framework in order to propose or predict the evolutionary steps. The challenge is to provide a delicate balance between costs and customers satisfaction. In this framework, caching-related practices, content personalization processes, and data mining techniques seem to offer an effective roadmap for the further evolution of CDNs

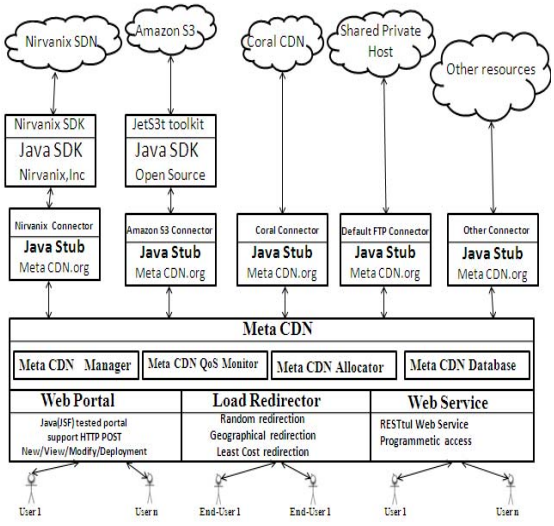

Fig. 3. Amazon simple storage service (S3)

VI. Virtualization And Other Technologies

The cloud computing builds upon the advantages of virtualization .Virtualization [13] has the potential to deliver real benefits of increased reliability, increased utilization and decreased cost. But that ability is really unleashed when it is allied to automation and to dynamic provisioning and de-provisioning (so that the virtualized resourced are automatically configured when needed, and the resource they consume released back to the pool when no longer needed). By far the most broadly embraced is virtualization. 70% of

companies across the survey either are already using server virtualization or planning to. Although the intention to embrace server virtualization is fairly strong across all regions there is significant regional variation in how much companies are already deploying the technology. In Austria for instance, 83% of the sample are already using server virtualization (followed closely by 74% in the Netherlands and 68% in the UK). Only 11% of companies interviewed in Spain are currently using server virtualization (closely followed by 14% in Belgium). Of those companies embracing server virtualization, 65% are doing it to improve the reliability of service levels and 56% to achieve cost savings. This is fairly uniform across the sizes and sectors of companies, although the public sector stands out with 68% of organizations are looking for cost savings.

VII. Conclusion And Future Thoughts

Finally we can conclude that cloud computing is an emerging computing technology for delivering the IT services as computing utilities. As clouds provides the sharing of resources as computing utilities. In this paper we discussed the architecture for global cloud exchange and allocation of resources in markets and also our vision of cloud computing as 5th utility services. We presented several cloud efforts from market oriented to third party content delivery networks which enables the successful adoption of cloud computing and provides the high performance content delivery via storage clouds. The virtualization and consolidation of Datacenters and servers will helps to improve the cheapest and environment friendly services. The use of virtual Machines may helps to improve the content delivery process. In MetaCDN optionally we can use Oracle as backend for storage of user accounts. As the technology evolves the future advancements will come into the light which will provide the better computing experience to the future generation as the 5th utility.

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