A Study of the Cloud Computing Services and Deployment Models: Cloud Computing

Tajinder Kaur
Department of Computer Science, Guru Nanak Khalsa Girls College, Baba Sang Dhesian Goraya, Punjab

***Abstract*- Cloud computing now easily tops any list of topics in computer science because of its far reaching involvements in many areas in computing, especially Big Data. Moreover, It is a one of the most emerging technology due to the provision of various computing infrastructure and services. Cloud computing has evolved through a number of phases that include mainframe computing, cluster computing, and grid computing, parallel computing, distributed computing and utility computing. Cloud computing is often considered the successor of grid, cluster and, mainframe computing. Cloud computing is the delivery of many services through the Internet. These resources include tools and applications like databases, infrastructure, platforms, data storage, servers, networking, and software. Many people and businesses use cloud for a number of reasons including cost savings, increased productivity, speed, efficiency, high performance, scalability, high computing power and security. This paper presents the definition of cloud computing, its characteristics, different cloud services, deployment model and security issues that face the cloud computing.**

Index terms- Cloud computing, Evolution, Service models, Deployment Model and Security Challenges.

I. INTRODUCTION

Many people believe that the term cloud computing is just another buzzword, but the term cloud computing has been used over the years to mean a number of technologies, including: grid computing, utility computing, software-as-a service (SaaS), peer-to-peer computing and remote processing. In cloud computing, the word "Cloud" is used as a symbol of the most popular computer network means "The Internet". Cloud computing is the on-demand delivery of networking, computing power, storage, applications, and other IT services via the internet with a pay-as-you-go pricing. It states that the cloud computing purpose is storing and accessing the data and other resources over the internet instead of personal computer's hardware. The data can be videos, music, files, images, documents, and many more. Furthermore, many of the daily things we do that made possible through the cloud—like email, file storage and backup, social media, Google drive, drop box and banking. Rather than keeping files on native computer, cloud storage make it possible to save them to a remote server provider [1] [3]. The cloud computing technology has become in demand because it provides benefits to people and businesses alike, including lower costs, easier access, and reduced management cost, free provision of services and higher reliability. Cloud service examples are Google Drive, Apple iCloud, Amazon Cloud Drive, Microsoft One Drive and Oracle Cloud. The concept of cloud computing is based on the Everything-as-a-Service, mostly referred as XaaS [2], where the Fig. 1 shows the different components of a system—Software-as-a-Services (i.e. SaaS services are End-user applications, Scientific applications, photo editing, CRM, and social networking sites), Platforms-as-a-Services (i.e. PaaS mainly focusing on the runtime environment where applications can deploy and Infrastructure-as-a-Services(i.e. IaaS provides services like virtualized hardware, servers, storage and networking). The Cloud provides four deployment models for consumers that are Public, Private, Hybrid and Community models.

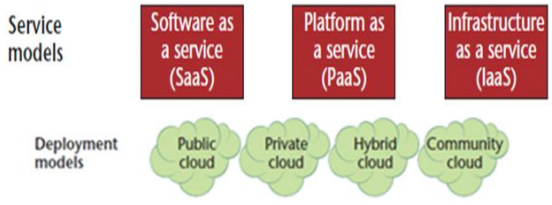

Fig. 1 Cloud Computing Services & Deployment Models

II HISTORY AND OTHER DEFINITION OF CLOUD COMPUTING

The Cloud Computing concept came into the spotlight in the year 1950 with access via thin/static clients and the implementation of mainframe computers. Then in 1961, John McCarthy delivered a speech at MIT in which he suggested that computing services will be readily available on demand service [4], just as other utility services such as water, electricity, telephone, and gas that computing can be sold like a utility. In the 21st century, this model has been referred to as utility computing or as cloud computing. Using cloud computing you can go with Pay-per-use or Pay-As-u-go Model. In 1999, Salesforce.com became the 1st company to enter the cloud arena, excelling the concept of providing enterprise-level applications to end users through the Internet. Then in 2002, Amazon came up with Amazon Web Services, providing services like computation, storage, and even human intelligence. In 2009, Google Apps, Hadoop, Salesforce.com, Manjra soft Aneka and Microsoft's Windows Azure also started to provide cloud computing enterprise applications. Other companies like HP and Oracle also joined the stream of cloud computing, for fulfilling the need for greater data storage.

Many definitions have been introduced in the last years to define exactly what "cloud Computing" are: According to Buyya et al. [5] have defined it as follows: "Cloud is a parallel and distributed computing system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service-level agreements (SLA) established through negotiation between the service provider and consumers." The National Institute of Standards and Technology (NIST) [6] characterizes cloud computing as "a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." Vaquero et al. [7] have stated "clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service Level Agreements." definition proposed by the U.S. National Institute of Standards and Technology (NIST)[6] "Cloud computing is a model for enabling ubiquitous, 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".

III. EXISTING TECHNOLOGY

Mainframes: Mainframes were powerful, highly reliable computers, specialized in large data movement and massive input/output (I/O) operations. They are mostly used by large organizations for bulk data processing tasks such as online transactions, enterprise resource planning, and other operations involving the processing of significant amounts of data. The main application of mainframes is Batch Processing. The evolved version of application which are still used for transaction processing, i.e. airline ticket booking, online banking, government services and supermarkets.

Clusters: This technology is faster, more powerful, high availability of resources, high performance and cheaper cost than mainframe computers[8].High performance or cluster computing is formed of a large number of groups that are connected through a LAN so that is act as a single machine. Due to its faster processing speed, better integrity it solves the complex problems more efficiently. It is used for critical applications some are Earthquake Simulation, Weather Forecasting, Google search engine etc.

Grid: Grid computing is an evolution of the cluster computing [9]. It aggregates the geographically dispersed clusters with an internet to solve a particular task. These clusters belonged to heterogeneous computing nodes, and arrangements are made among them to share the computing power, data storage and memory.

IV CHARACTERISTICS OF CLOUD COMPUTING

- On demand access
- No upfront commitments
- Pay-per-use model
- Nice Pricing
- Efficient resource allocation
- 24/7 hours available
- Easily manageable, flexible and scalable
- Energy efficiency
- Increased agility
- Service orientation
- Security
- High performance and reliability
- Accessible from anywhere

V MAJOR CATEGORIES OF CLOUD COMPUTING SERVICES

The cloud computing is the capability to deliver, on demand, a variety of IT services to users over the internet. Cloud computing service offerings into three major categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS)[10].

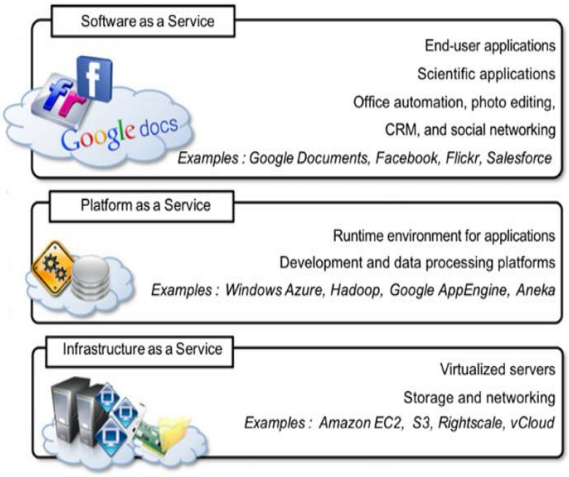

Fig. 2 Cloud Computing Services

Infrastructure as a Service: Hardware as a Service or Iaas is a bottom layer which delivers infrastructure on demand in the form of virtual storage, networking, virtual machines, hardware and other resources. They deliver customizable infrastructure on user request to Iaas provider. Then provider creates one or more virtual machines on the demand of the client. The user can able to deploy and run the software stack in the virtual machine. Iaas help the consumer to reduce the cost of purchasing and managing their storage, networking and physical servers. The cloud service provider hosts the IaaS infrastructure services in which the users access these computing resources in a virtualized environment and priced according to the specific resource of the virtual hardware, memory, number of processors, disk storage etc. Iaas service providers are Amazon EC2 and S3, GoGrid etc. Besides the virtual machine management capabilities, additional services can be provided by Iaas that generally including the SLA(Service Level Agreement) resource-based allocation, workload management, support for infrastructure design through advanced Web interfaces, and the ability to integrate third-party[11].Iaas services provides by public clouds vendors such as Amazon, GoGrid, Joyent, Rightscale, Terremark, Rackspace, ElasticHosts, and Flexiscale, which has their own large datacenters and give access to their computing infrastructure as a renting bases.

Fig. 3 Iaas Services

Platform as a Service: Paas providers commonly provide a development and deployment environment that allow users to create and run their applications on cloud with little or no trouble to low-level details of the platform. It is the responsibility of the Paas service provider to offer scalability and to manage fault tolerance, while users are requested to focus on the logic of the application developed by the provider's APIs, programming tools and libraries [11]. Client designs their applications and are not concerned with hardware that may be physical or virtual, server, storage, operating systems and other low-level services. The core middleware or hypervisor is in charge of managing the resources and scaling and descending applications on demand or automatically, according to the commitments made

by users in SLA. This approach increases the level of abstraction at which cloud computing takes advantage but also some restrictions for the user. The user works under a more controlled environment.

PaaS providers usually support multiple programming languages in platforms include Python and Java (e.g., Google AppEngine), .NET languages (e.g., Microsoft Azure), and Ruby (e.g. Heroku), force.com or Saleforce.com has made its own programming language (Apex) and an Excel-like query language, which provide higher levels of abstraction to key platform functionalities [12]. The most popular is Microsoft Windows Azure [11], which provides a comprehensive framework for building service-oriented cloud applications on top of the .NET technology, hosted on Microsoft's data centers

Fig. 4 Paas Services

Software as a Service: Saas is top most layer of the cloud computing service. In this model, consumers neither need install anything on their personal computer, nor have to pay considerable up-front costs to purchase the software and the required licenses. They simply access the application website, enter their credentials and billing details, and can instantly use the application, which, in most of the cases, can be further customized for their needs. On the provider side, the specific details and features of each customer's application are maintained in the infrastructure and made available on demand. Software-as-a-Service is a software distribution model in which applications are hosted by a vendor and made available to customers over a network, typically the Internet. The common features of desktop applications—such as office automation, document management, photo editing, and customer relationship management (CRM) software—are duplicates on the provider's infrastructure and made more scalable and accessible through a web browser on demand and billing done through renting weekly, monthly, yearly and pay-per -use. These applications are shared across multiple users whose interaction is isolated from the other users. Examples are Google drive, social networking site, gmail, etc.

Fig. 5 Saas Services

VI DEPLOYMENT MODELS

There are mainly four types of deployment models in the cloud. Client can use the different cloud model according to their requirement like privacy, accessibility, control, security, dynamic provisioning, etc. The deployment models are Public, Private, hybrid and Community cloud.

Public Cloud: Public cloud offered the services which are made available to anyone, from anywhere, and at any time through the Internet. Public clouds are working as a multi-tenancy. It is meant to serve a multiple of users, not a single customer. Any user can easily sign in with the cloud provider, enter her credential and billing details, and use the services offered and requires a virtual computing environment that is separated or isolated, from other users. This is a fundamental requirement to provide effective monitoring of user activities and guarantee the desired level of performance.

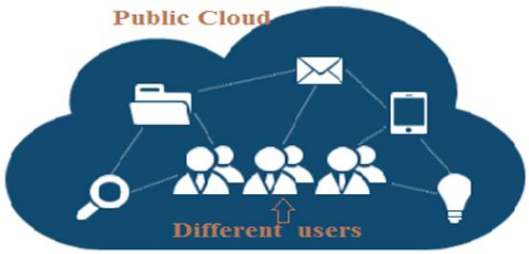

Fig. 6 Public Cloud

A public cloud can offer various services: infrastructure, platform, or software. For example,

- Amazon EC2 (Amazon Elastic Compute Cloud) is a public cloud that provides infrastructure as a service.

- Google AppEngine is a public cloud that provides an application development platform as a service.
- SalesForce.com is a public cloud that provides software as a service.
- IBM's Blue Cloud, Sun Cloud, and Windows Azure Services Platform.

Private Cloud: The private clouds similar to public clouds, but their resource-provisioning model is limited within the boundaries of an organization. A private cloud is a virtual distributed environment that relies on a private infrastructure and provides internal users with dynamic provisioning of computing resources and other services. A Private cloud provides more security and privacy than public cloud also increase the reliability. It gives more control of our tasks and fulfills the requirements as per our need.

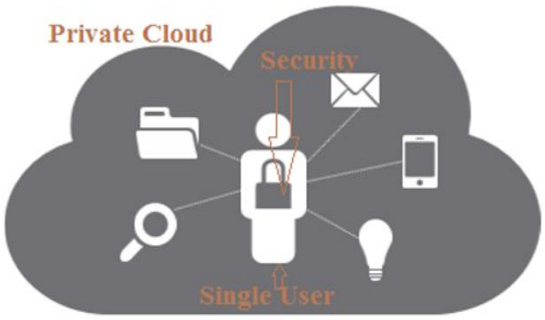

Fig. 7 Private Cloud

The benefits of private clouds therefore are:

- Higher security and privacy: The public cloud services can implement a certain level of security, but private clouds using techniques such as warranties, distinct pools of resources with access restricted to connections made from behind one organization's firewall, dedicated leased lines and on-site internal hosting etc. Private clouds used when it is necessary to keep the processing of information within an enterprise's premises or it is necessary to use the existing hardware and software infrastructure.
- Infrastructure and ensuring SLAs: Quality of service implies specific operations such as appropriate clustering, data replication, system monitoring and maintenance, and disaster recovery, and other uptime services can be commensurate to the application needs. Although public cloud vendors provide some of these features, not all of them are available as needed.
- More control: A private cloud is only accessible by a single organization that organization will have the ability to configure and manage their needs to achieve a tailored network solution. However, this level of control removes some the economies of scale generated in public clouds by having centralized management of the hardware.
- Hybrid Cloud: Hybrid cloud is the combination of both public and private cloud. Hybrid clouds allow industries to use existing IT infrastructures, maintain sensitive information within the premises, and naturally grow and shrink by provisioning external resources and releasing them when they're no longer needed. Security concerns are then only limited to the public portion of the cloud that can be used to perform operations with less restricted but that are still part of the system workload. It is a heterogeneous distributed system which comes from a private cloud that integrates additional services or resources from one or more public clouds. When resources or services are temporarily leased for the time required and then released. This practice is also known as cloudbursting.

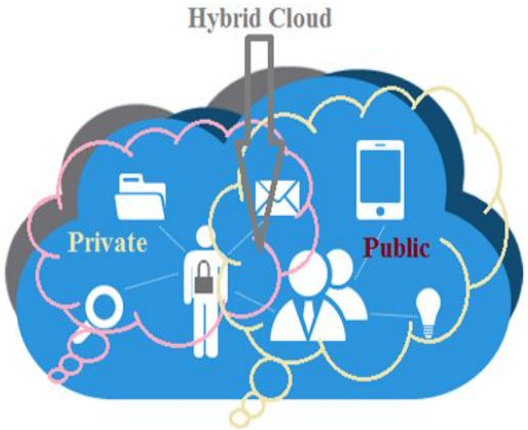

Fig. 8 Hybrid Cloud

For example, Infrastructure management software such as Open Nebula exposes the capability of integrating resources from public clouds such as Amazon EC2 and Open Nebula, advanced schedulers such as Haizea can be integrated to provide cost based scheduling.

Community Cloud: Community clouds are distributed systems created by combining the services of different clouds such as public, private and hybrid cloud to address the specific needs of an industry, a community, or a business sector. The National Institute of Standards and Technologies (NIST) define community clouds as follows [6]:"The infrastructure is shared by several organizations and supports a specific community that has shared concerns, e.g., mission, security requirements, policy, etc. It may be managed by the organizations or a third party and may exist on premise or off premise". It means the users of a different or specific community cloud come into a well-identified community they are sharing the same concerns, they can be government bodies, industries, or even simple users, but all of them focus on the same issues for their interaction with the cloud. This is a different scenario than public clouds, which serve a multitude of users with different needs. Community clouds are also different from private clouds, where the services are generally delivered within the institution that owns the cloud.

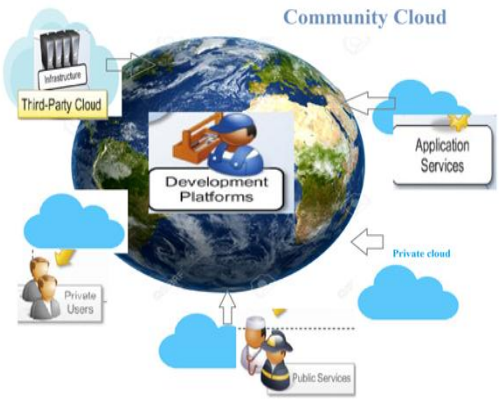

Fig. 9 Community Cloud

The benefits of the community clouds are the following:

- Openness: By removing the dependency on cloud vendors. The community clouds are open systems .
- Community: Being based on a collective that provides resources and services, the infrastructure turns out to be more scalable because the system can grow simply by expanding its user base.
- Graceful failures: There is no single provider or vendor in control of the infrastructure, there is no single point of failure.
- Environmental sustainability: The community cloud is supposed to have a smaller carbon footprint because it harnesses underutilized resources. Moreover, these clouds tend to be more organic by growing and shrinking in a efficient manner which support to the demand of the community, which in turn sustains it.

VII CLOUD COMPUTING CHALLENGES AND RISK

Cloud computing, continuously gaining popularity due to the dynamic provisioning of cloud resources, ease to access anywhere at anytime through the internet. New challenges and risk are regularly being constituted to the cloud provider, developer and users. Issues relate to user privacy, data security, data lock-in, availability of service, disaster recovery, performance, scalability and energy-efficiency.

Challenges in Cloud Computing

- Security
- Performance Monitoring
- Meta Scheduling
- Energy Efficient load Balancing
- Scale Management
- SLA & Qos Architectures
- Green IT
- Interoperability & Portability
- Robust Services Abstraction

Security and Privacy concerns: Security in terms of confidentiality, secrecy, and protection of data in a cloud environment is prominent challenge. Organizations do not own the infrastructure they use to process data and store information. This condition poses challenges for confidential data, which organizations cannot afford to reveal. Therefore, assurance of the confidentiality of data and compliance to security standards, which give a minimum guarantee on the treatment of information on cloud computing systems, is sought. Legal and regulatory issues may also arise. These are specifically tied to the ubiquitous nature of cloud computing, which spreads computing infrastructure across diverse geographical locations. Different legislation about privacy in different countries may potentially create disputes as to the rights that third

parties that including government agencies have to your data.

Data Lock-In and interoperability: Another concern of cloud computing users is about having their data locked-in by a certain provider. Users may want to move data and applications out from a provider that does not meet their requirements, but the user cannot do this because whole data are managed by the cloud provider. This can occur either because the customer wants to find a more suitable solution for customer needs or because the vendor is no longer able to provide the required service the cloud computing infrastructures and platforms do not employ standard methods of storing user data and applications. Consequently, they do not interoperate and user data are not portable. The presence of Cloud Computing Interoperability Forum standards that are actually implemented and adopted in the cloud computing community could give room for interoperability and then lessen the risks resulting from vendor lock-in.

Availability, Fault-Tolerance and Disaster Recovery: The users will have belief about the service level to be provided once their applications are moved to the cloud. These assumptions include availability of the service, its overall performance and what measures are to be taken when something goes wrong with the system, service or its components. The users seek for a warranty i.e. SLA before they can comfortably move their business to the cloud. An SLA specifies the details of the service to be provided, including availability and performance guarantees. The SLA must be agreed upon by all parties, and penalties for violating the expectations must also be approved.

VIII CONCLUSION

Cloud computing is not just about designing a new type of computing. Cloud computing is a one of the most emerging technology and its popularity increasing very rapidly. Many companies providing the various services to the consumer on rent bases like Google, Amazon Services, Oracle, Microsoft, etc. Today, IT companies shift their business over the cloud based architecture, because it provides physical infrastructure to build an application, the developer deploys their application on virtual environment and user run many software without installing on their personal computers. Moreover, user can store their personal data in the cloud as per their requirement. This paper discussed the history, cloud computing services, security issues and its various technologies which recently used by IT industries. The security is necessary to protect the data during upload into the server and ensure that the data do not get stolen or corrupted on the way into the database. Secondly, it is necessary to the stores the data in the data warehouse to ensure that they are encrypted at all times. Thirdly, the access to those who are authorized person data, this control should also be applied to the hosting company, including the administrators or service provider. Some security risks are more challenging issues of cloud computing because new technology faces security assaults.

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