International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 05, May 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

CLOUD COMPUTING: FUTURE AND CHALLENGES

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ABSTRACT

Cloud computing is one of the most used terms in computing world now. It is almost everywhere, from a simple mobile application to web hosting platforms, you can name it all. There is no denying that it is the one of the fastest growing industries in world and a lot more are left to be explored. Hence,it has a humongous amount of potential to grow, at the same time it has many real time challenges to face. This paperdeals about its growth and the hurdles it has to overcome.

Keywords: IaaS, SaaS, PaaS, VM.

I. INTRODUCTION

1.1 Cloud Computing: An Overview

1.1.1 Definition

Cloud computing is a computing paradigm, where a large pool of systems are connected over public or private networks, to provide the scalable infrastructure for application, data and file storage. With the advent of this technology, the cost of computation, application hosting, content storage and delivery is reduced significantly.

Simply put, cloud computing is the delivery of computing services-servers, storage, databases, networking, software, analytics and more, over the Internet ("the cloud"). Companies offering these computing services are called cloud providers and typically charge for cloud computing services based on usage, similar to how you are billed for water or electricity at home.

1.1.2 Uses of Cloud of Computing

Cloud computing has an extensive use in our daily lives. It is vastly used for online services like email, edit documents, store pictures, etc. The first cloud computing services are barely a decade old, but already a variety of organizations from government agencies to NGO's, tech startups to global companies and all other organizations are using it. The following are the main uses of this technology:-

- Creation of new Apps and services
- Store, back up and recover data
- Host websites and blogs
- Stream audios and video
- Deliver software on demand
- Analyzing data for patterns and predictions

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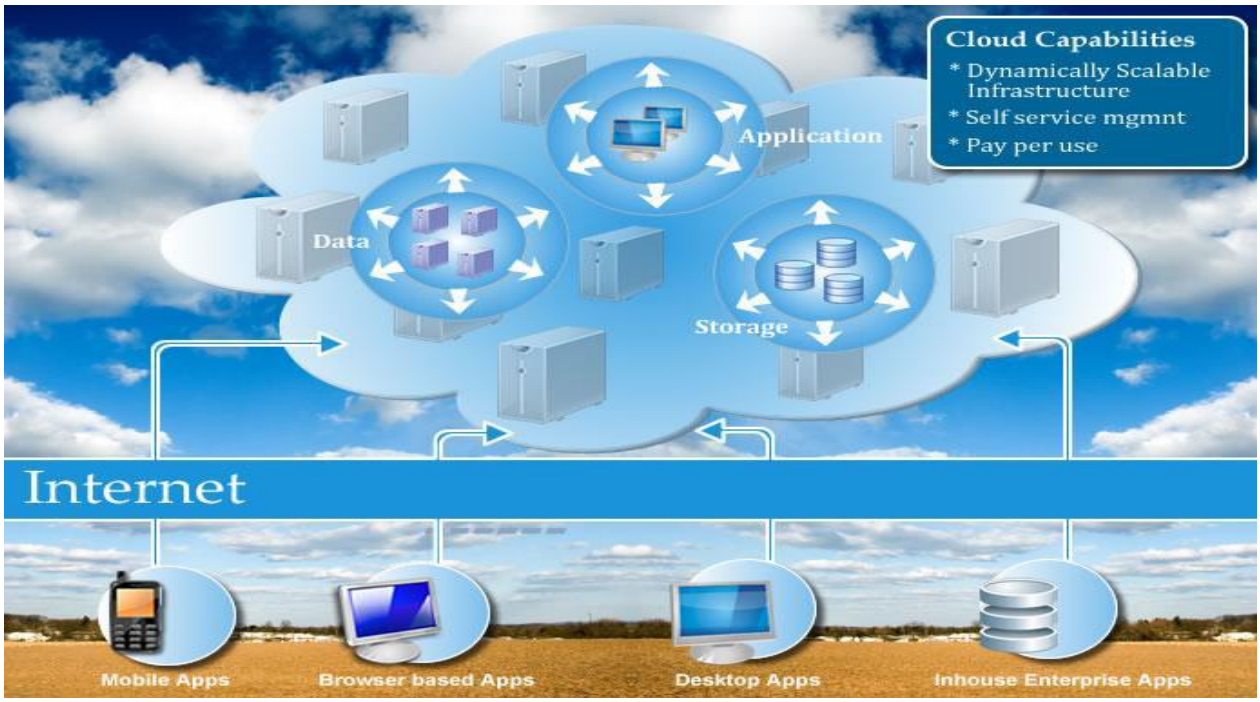

Fig- 1: Conceptual view of cloud computing

1.1.3 Characteristics

Cloud computing provides us many salient features that are different from traditional service computing, which are as follows:

- *Cost*: Cloud computing eliminates the capital expense of buying hardware and software and setting up and running on-site datacenters—the racks of servers, the round-the-clock electricity for power and cooling, the IT experts for managing the infrastructure.The exact pricing scheme may vary from service to service. For example, a SaaS provider may rent a virtual machine from an IaaS provider on anhourlybasis. On the other hand, a SaaS provider that provides on-demand customer relationship management (CRM) may charge its customers based on the number of clients it serves (e.g. salesforce).
- *Multi-Tenancy*: In a cloud environment, services ownedby multiple providers are co-located in a single data center.The performance and management issues of these servicesare shared among service providers and the infrastructure providers. The layered architecture of cloud computing provides a natural division of responsibilities: the owner of eachlayer only needs to focus on the specific objectives associatedwith this layer. However, multi-tenancy also introducesdifficulties in understanding and managing the interactionsamong various stakeholders.
- *Shared resource pooling*: The infrastructure provider offers a pool of computing resources that can be dynamically assigned to multiple resource consumers. Such dynamic resource assignment capability provides much flexibility to infrastructure providers for managing their own resource usage and operating costs.

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ISSN (O) 2319 - 8354
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- *Service Oriented:* Cloud computing adopts a service-driven operating model. It is very service oriented and provides on demand service to its user. It is designed in such a way so that a user can bear or utilize its service anytime and as per his/her wish. Hence, it places a strong emphasis on service management. In a cloud, the services provided are according to the Service Level Agreement (SLA) negotiated with its customers. SLA is therefore, a critical objective for every user.
- *Geo-distribution and ubiquitous network access:* Clouds are generally accessible through the Internet which uses the Internet as a service delivery network. Hence, any device with Internet connectivity,be it a mobile phone, a PDA or a laptop, It can access cloud anywhere. Additionally, to achieve high network performance and localization, many of today's clouds consist of different data centers around the globe. Hence, providing leverage of geo-diversity and maximum service utility.

1.2 Business Model/Services provided by the cloud

Cloud Computing employs a service-driven business model. In other words, hardware and platform level resources are provided as services on demand basis. A service should have following traits:

- Low barriers to entry, making them available to small businesses
- Large scalability
- Multi tenancy
- Device independence

These services are broadly categorized into following three services:

1. *Infrastructure as a Service (IaaS):* IaaS refers to an on-demand provisioning of infrastructural resources, usually in terms of Virtual Machines or VMs.For better understanding, one can say it means renting of IT infrastructure such as servers and VMs, storage, networks, operating system, etc. The cloud owner who offers IaaS is called and IaaS provider, and pay as you go on basis. Examples of IaaS provider include Amazon EC2, GoGrid, etc.

2. *Platform as a Service (PaaS):* PaaS refers to providing platform layer resources, including operating system support and software development frameworks.PaaS services include application design, development, testing, deployment, and hosting on cloud dynamically. PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development. Examples of PaaS include Google App Engine, Microsoft Windows Azure and Force.com.

3. *Software as a Service (SaaS):* SaaS refers to providing on-demand applications over the Internet on demand and typically on subscription basis. With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle any maintenance, like software upgrades and securitypatching.Examples of SaaS providers include Salesforce.com, Rackspace and SAP Business ByDesign.

IJARSE
ISSN (O) 2319 - 8354
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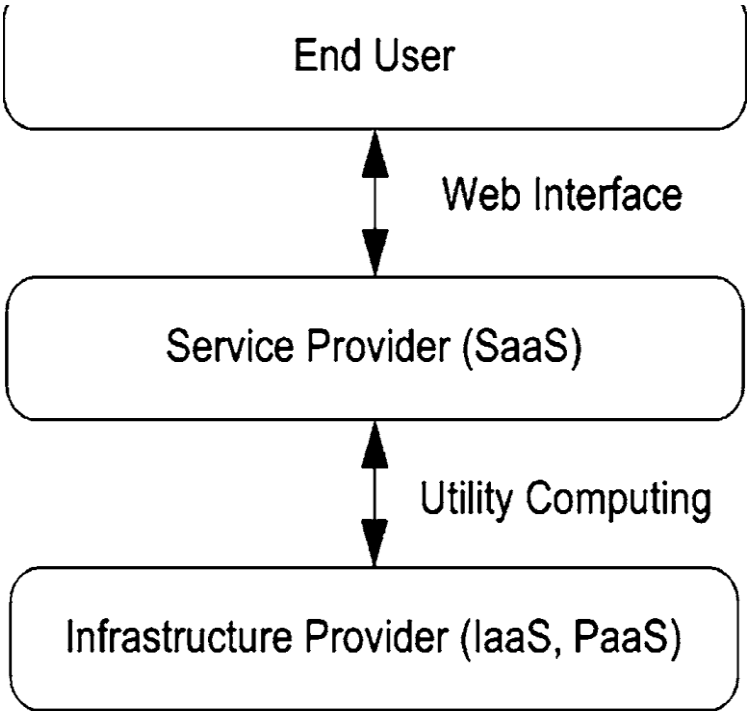

Fig -2: Business model

1.3 Types of Cloud

There are many issues to consider when moving an enterprise application to the cloud environment.Deploying cloud 0computing can differ depending on requirements, and the following three deployment models have been identified, each with specific characteristics that supports the needs of the services and users of the clouds in particular ways.

1. Private Cloud: This is also known as the internal clouds.Private clouds are designed for exclusive use by a single organization. A private cloud may be built and managed by the organization or by external providers. A private cloud offers highest degree of control over performance, reliability and security.

2. Public Cloud: A Cloud in which service providers offer their resources as services to the general public, is known as public cloud. Public clouds are owned and operated by a third-party cloud service provider, which deliver their computing resources like servers and storage over the Internet. With a public cloud, all hardware, software and other supporting infrastructure is owned and managed by the cloud provider. However, it lacks in fine-grained control over data, network and security which hampers many business scenarios.

3. Hybrid Cloud: A hybrid cloud is a combination of public and private cloud models that tries to address the limitations of each approach. In a hybrid cloud, part of the service infrastructure runs in private clouds while the remaining part runs in public clouds. It is bound together by technology that allows data and applications to be shared between them. By allowing data and applications to move between private and public clouds, hybrid cloud gives businesses a greater flexibility and more deployment options.

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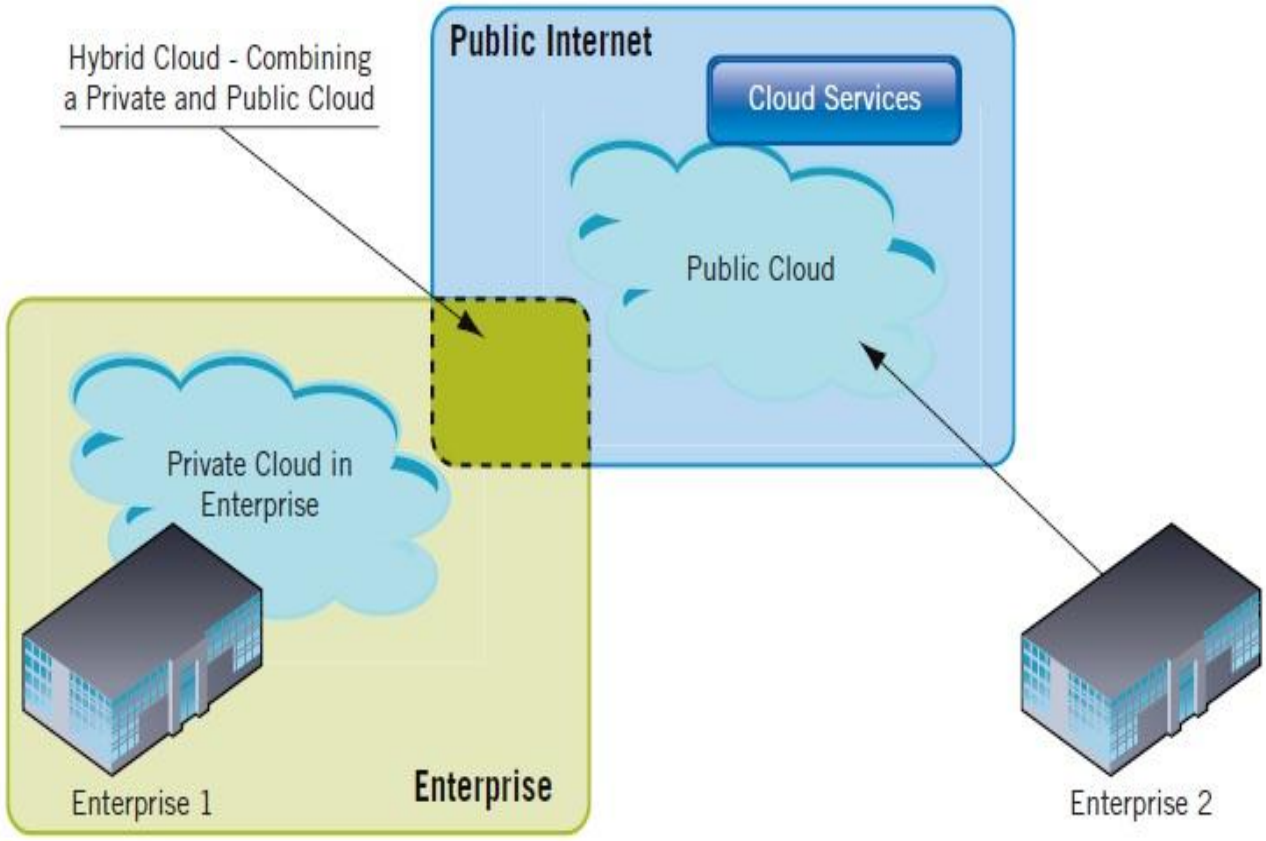

Fig 3. Types of Cloud and their application

II. Working of cloud

The working of cloud is very different from primitive networking techniques such as LAN etc. Unlike shared grids, which are based on open source technologies, clouds are a proprietary technology. Only the resource provider knows exactly how their cloud manages data, job queues and security requirements.

The cloud consists of layers, mainly back end layers and front end layers. The front end layers are the parts we see and interact with while the back end consists of the hardware and the software architecture that delivers the data we see in front end. These layers altogether is called Cloud Architecture. Front end layers are accessed by clients, and data is delivered and managed through data centers.

2.1 Clients

Clients are the devices or systems by which we access the cloud and its services. It might be a regular desk PC, but it also can be laptops, mobiles, PDAs etc. as cloud computing provides mobility and ubiquitous network access. The clients are broadly divided into three categories, they are:

- Mobile: Mobile devices include PDAs or smartphones, like a Balckberry, Windows, Android Mobile Smartphones, or an Apple iPhone.

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- Thin: Clients are computers that do not have internal hard drives, but rather let the server do all the work, but then display the information.
- Thick: This type of client is a regular computer using web browser like firefox or chrome to connect to the cloud.

2.2 Datacenters

The Datacenters is a large collection of servers where the application to which we subscribe is housed. It is a large room filled with racks of servers to which the cloud connects via Internet. Cloud brings in the concept of virtualizing the server in which different softwares and drivers are installed which halves the number of physical server.

2.3 Cloud Computing Architecture

The Cloud architecture is divided into mainly four layers which allow the cloud to be accessed, managed and perform its job efficiently.

- *The Hardware layer:* The layer is responsible for managing the physical resources of the cloud, including the physical servers, routers, switches, power and cooling systems. In practice, the hardware layer is typically implemented in data centers.
- *The Infrastructure Layer:* Also known as the virtualization layer, the infrastructure layer creates a pool of storage and computing resources by partitioning the physical resources using virtualization technologies such as Xen, KVM and VMware. The Infrastructure layer is an essential component of cloud computing, since many key features such as dynamic resource assignment are only made available through this layer.
- *The Platform layer:* Built on top of the infrastructure layer, the platform layer consists of operating systems and application frameworks. The purpose of platform layer is to minimize the burden of deploying the applications directly into VM containers. For example, Google App Engine operates at the platform layer to provide API support for implementing storage, database and business logical typical web applications.
- *The Application layer:* At the highest level of hierarchy, the application layer consists of actual cloud applications. Different from traditional applications, cloud applications can leverage the automatic-scaling feature to achieve better performance, availability and lower operating cost.

  The architecture of cloud computing is more modular and each layer is loosely coupled with layers above and below, allowing each layer to evolve separately. This is to the design of OSI model for network protocols. This architecture allows cloud to host a wide range of applications while reducing the management cost.

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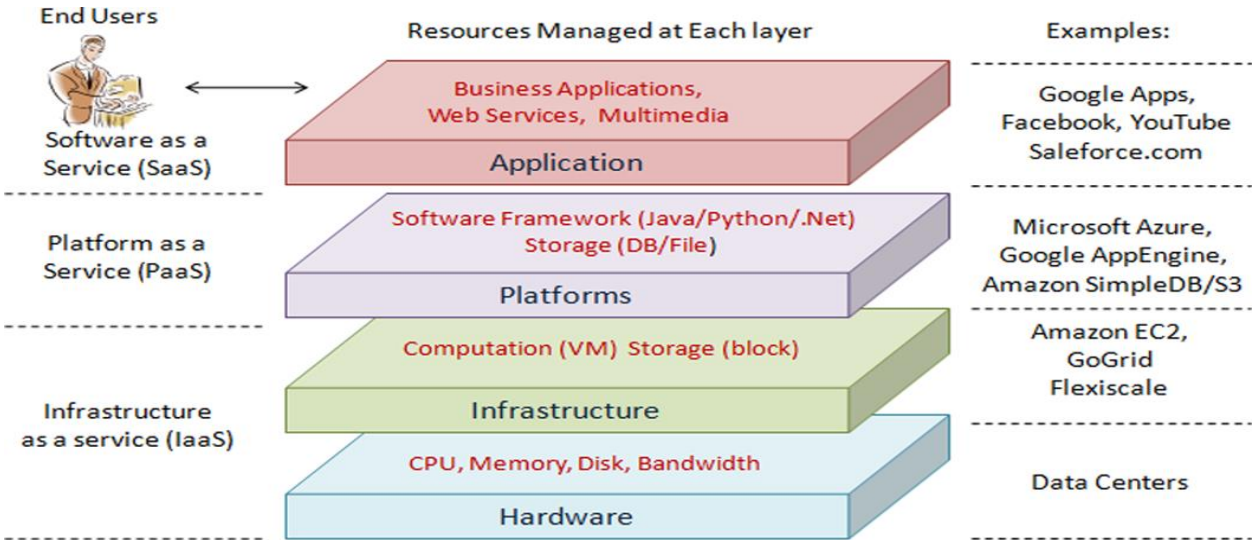

Fig 4 Cloud Computing Architecture

III. GROWTH AS AN INDUSTRY

The cloud computation has created a world-wide phenomenon. Ease of availability, connection and cost management has made it the top choice for many business organizations. The cost of start-ups and data analytics in accordance of it management has been made a lot easier with the advent of this technology.

There has been a tremendous growth in this industry in previous years and is expected to grow even more in coming future. From a recent survey conducted by IDC it has been discovered that cloud computing is projected to increase from $67B in 2015 to $162B in 2020 attaining a compound annual growth rate (CAGR) of 19%, which is huge.

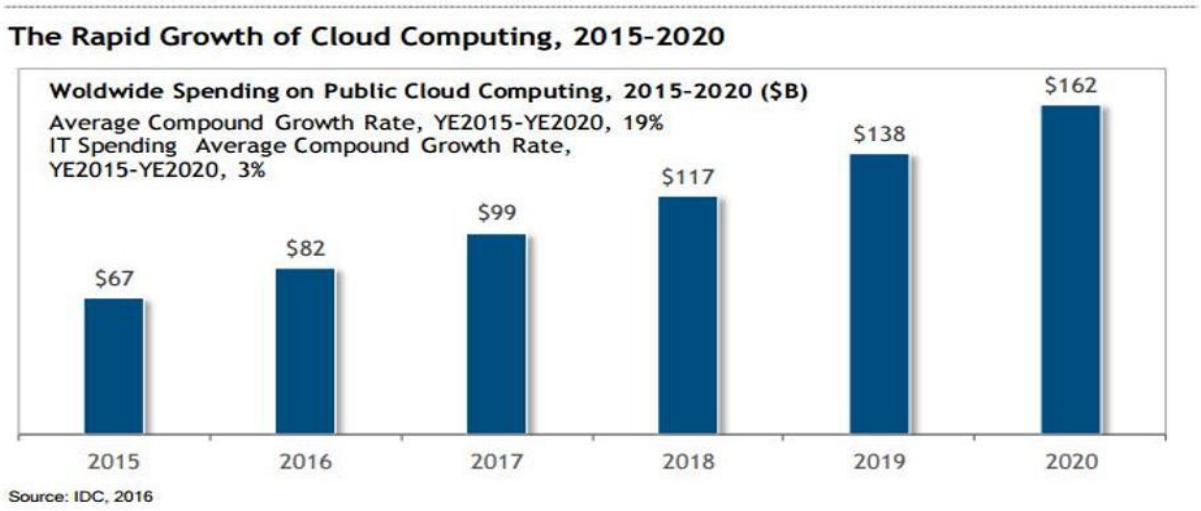

Fig 5 Growth of Cloud in per billion

IJARSE
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Table 1. Worldwide Public Cloud Services Forecast (Millions of Dollars)

	2016	2017	2018	2019	2020
Cloud Business Process Services (BPaaS)	40,812	43,772	47,556	51,652	56,176
Cloud Application Infrastructure Services (PaaS)	7,169	8,851	10,616	12,580	14,798
Cloud Application Services (SaaS)	38,567	46,331	55,143	64,870	75,734
Cloud Management and Security Services	7,150	8,768	10,427	12,159	14,004
Cloud System Infrastructure Services (IaaS)	25,290	34,603	45,559	57,897	71,552
Cloud Advertising	90,257	104,516	118,520	133,566	151,091
Total Market	**209,244**	**246,841**	**287,820**	**332,723**	**383,355**

Source: Gartner (February 2017)

Fig- 6: Growth of services provided by cloud

3.1 Growth in services provided by cloud

As the data in figure 6 show that by year 2020 there will be an average increase of 35% in almost all services rendered by the cloud. This is a huge growth rate, opening many future prospects. This marksan embark of revolution in coming trends in cloud. This also suggests that in coming future hybrid clouds will be more in use as they have upper edge over private and public clouds.

3.2 Future Trends

Cloud Computing will be the future of IT industry, data sharing and many business platforms. An Oxford Economics and SAP study of cloud computing generated key points that were found by comparing a recent survey to one conducted a few years ago. Forbes Magazine shared these points, some of which include:

- Top-line growth, collaboration among employees, and supply chain are the three areas enterprises expect cloud computing to impact most in three years.
- Developing new products and services, new lines of business and entering new markets are three key areas in which cloud computing is transforming enterprises.
- 58% of enterprises predict their use of cloud computing will increase top-line revenue growth in three years.
- 67% of enterprises say that marketing, purchasing, and supply chain are somewhat and mostly cloud-based as of today.

IV. CHALLENGES AND PROPOSED SOLUTION

The cloud computation has many benefits such as cost cutting, ubiquitous network access but it has many issues too. As research on cloud is in its early stage and many existing issues have not been fully addressed yet. Also, new challenges keep on emerging from industry applications.

IJARSE
ISSN (O) 2319 - 8354
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In this section we see some of the challenging issues in cloud computing.

4.1 Lack of resource/expertise

As the industry is growing day by day, the demand of trained IT officials and tools to manage the cloud is increasing rapidly. Organizations are having a hard time to keep up these technologies and hence are spending time to research. Many common tasks performed by these specialists can be automated. Companies should useDevOps tools to monitor tasks like usage pattern and automated backups.

4.2 Security Issues

The main challenge to cloud computing is how it addresses the security and privacy concerns of businesses thinking of adopting it. The fact that the valuable enterprise data will reside outside the corporate firewall raises serious concerns. Hacking and various attacks to cloud infrastructure would affect multiple clients even if only one site is attacked. These risks can be mitigated by using security applications, encrypted file systems, data loss software, and buying security hardware to track unusual behavior across servers. This will reduce security issues upto 70%.

4.3 Availability of Service

Availability of service means to provide service to the costumer without being interrupted or discontinuing. Since the cloud is connected over Internet, it is obvious that the connection might get interrupted sometime or other. There is another obstacle of availability, which is Distributed Denial of Service (DDOS). The proposed solution to this is to have more than one cloud provider so as if one fails, there will be others and hence continuity can be maintained.

4.4 Performance Unpredictability

The cloud computing provides high performance but it is purely based on the cloud provider. It means, if your cloud provider is down you are down. It also mentions that the overloading of servers and transfer of huge amount data may cause disruption. To overcome this challenge Virtual Machines (VMs) which support high flash memory should be used.

4.5 Scalable Storage

Scalable storage refers to the storage technologies available at present to store the huge amount of data exchanged and stored everyday through cloud. The datacenters are not adequate enough to such huge data. Still research is going on to tackle this challenge as we fear that, in future as the use of cloud will increase the amount of data will increase exponentially. As a solution to this software frameworks such as MapReduce and its various implementations such as Hadoop and Dryad are designedfor distributed processing of data-intensive tasks.

IJARSE
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V.CONCLUSIONS

In this paper, we have seen about cloud computing and researched for its future growth and challenges. The paper mainly deals with its working and how efficient it is as a technology to take it forward and become a future of IT industry. Today it has a wide industrial application and many business organizations are using cloud for their purpose.

The reason for success of cloud is having vast range of characteristic benefits over primitive networking technologies. We have researched about them in this paper and how it helps the cloud computing industry to grow. Statistics suggest that by 2020 around 35% increase will be accounted in cloud computing industry and hybrid cloud will be emerging as most used cloud type.

However, with all these benefits cloud computing still lacks in some fields such as lack of expertise, security, availability of service, performance unpredictability and scalable storage. All of these are discussed above on the basis of our research and have been given a proposed solution. But, despite of these drawbacks cloud computing has still emerged as a hero in modern IT sector. Being a new technology, researches are still going on to make it a more better technology.

VI. ACKNOWLEDGMENT

It is an honor and pleasure to express our heartfelt gratitude to those who have helped us and also contributed towards this research. We are indebted to our guide Prof. Pragya Mishra, whose invaluable guidance, timely suggestion and encouragement inspired and motivated us to complete or research. We express gratitude to our parents for supporting and guiding us. We would also like to thank our college for supporting and helping us.

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