Emerging Technologies and Developments in Cloud Computing: A Systematic Review

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ABSTRACT

For many organizations, cloud computing is an adoptable technology with its dynamic nature of flexibility and usage of virtualized resources as services over the Internet. Because of this, it mostly impacts the IT industry and the academia. It is an exceptional alternative for both IT industry and academia to operate their information systems efficiently without spending more capital on computers and network devices, particularly under budget shortage. In this paper, we reveal advance review focusing on cloud computing concept including definition, history, characteristics, service models, deployment model, benefits and challenges. Furthermore, cloud computing architecture, cloud computing technologies and production, cloud computing applications in Indian context and motivation towards cloud in recent time are also discussed. This paper can be very helpful for new researcher of this field and who is interested in knowing what it is going on recently in cloud computing.

Key words: History of cloud computing, Cloud Models, Cloud architecture, recent Cloud technologies, Cloud based Applications, Challenges, Motivation towards Cloud.

1. INTRODUCTION

Cloud computing is an evolving and innovative computer mechanism that uses distant servers and the Internet to manage software as well as data for potential platforms. Cloud uses virtualization technology, multi-tenancy, web services [2], etc. to provide infrastructure over the Internet. For the creation of Software as a Service (SaaS) application multi-tenancy is essential. Multi-tenancy leases multiple applications share the same software platform. Virtualization offers the abstraction of autonomous hardware accessibly to every Virtual Machine (VM) program that uses web services to communicate over the Internet.

Cloud computing services can help researchers in science and engineering use resources in demands, expand their research productivity, raising computational cost and deliver improved results. Service providers are focused on providing resources based on requirement to fulfil the quality of service (QoS) necessities. For cloud computing, the term QoS refers to the degree of availability, consistency and efficiency provided by platform and infrastructure, and an application that host it. Cloud users, who imagine cloud providers to offers the eminence features, and cloud providers, who involve finding right trade-offs between operating QoS and costs rates, are critical. Nonetheless, determining ideal trade-off is a tough choice issue, often disturbed through the existence of SLA defining service-level objectives and economic penalties associated with service-level agreement (SLA) violations [5].

Rest of paper arranged in the following way: Section 2 gives the of cloud computing overview including definition, history, characteristics, cloud models, benefits as well as challenges. In section 3, Architecture of cloud computing are discussed. Cloud computing Technologies and productions are also discussed in section 4. In section 5, we define most popular business cloud applications in details. Applications of cloud computing based on Indian context are presented in section 6 and also highlights the motivation towards cloud in recent time in section 7. Finally, presents conclusion in section 8.

2. CLOUD COMPUTING OVERVIEW

This section provides a general cloud computing overview with relative concept including its definition, history and compression.

2.1 Definition

Cloud computing has become one of the most dominant technology to achieve substantial scale and difficult computing in the last decade. Cloud Computing provide resources such as Storage, application and services on demand pay as use concept [1] [2]. Users don't need to maintain the expensive resources.

Cloud computing relates to the resources distributed over the internet as services. Because of on demand infrastructure it provides computing resources as an elastic service [5]. Without any doubt cloud computing becomes more important and used technology. It is not a technology but new grand approach in electronic commerce, academia and research [3] [4]. It is proven an inexpensive green technology for small to higher companies or business.

NIST Cloud Computing definition - "Cloud computing is model for enabling convenient, on demand network access to

a shared pool of configurable computing resources (e.g. network server application and services) that can be rapidly
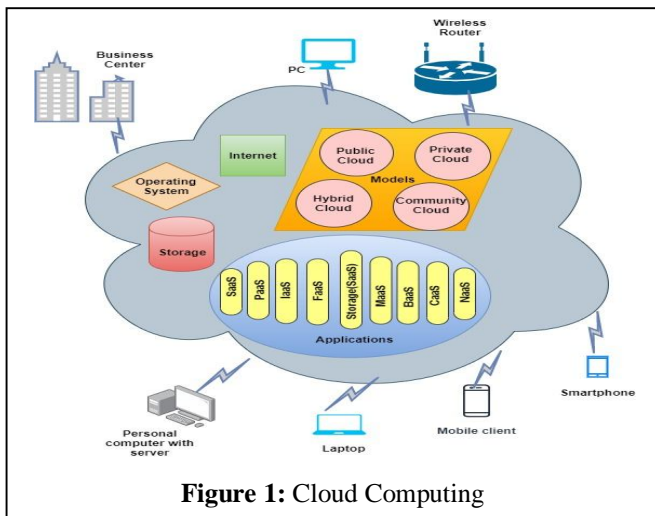

Figure 1: Cloud Computing

provisioned and released with minimal management effort" [6] clearly depicted in Figure 1.
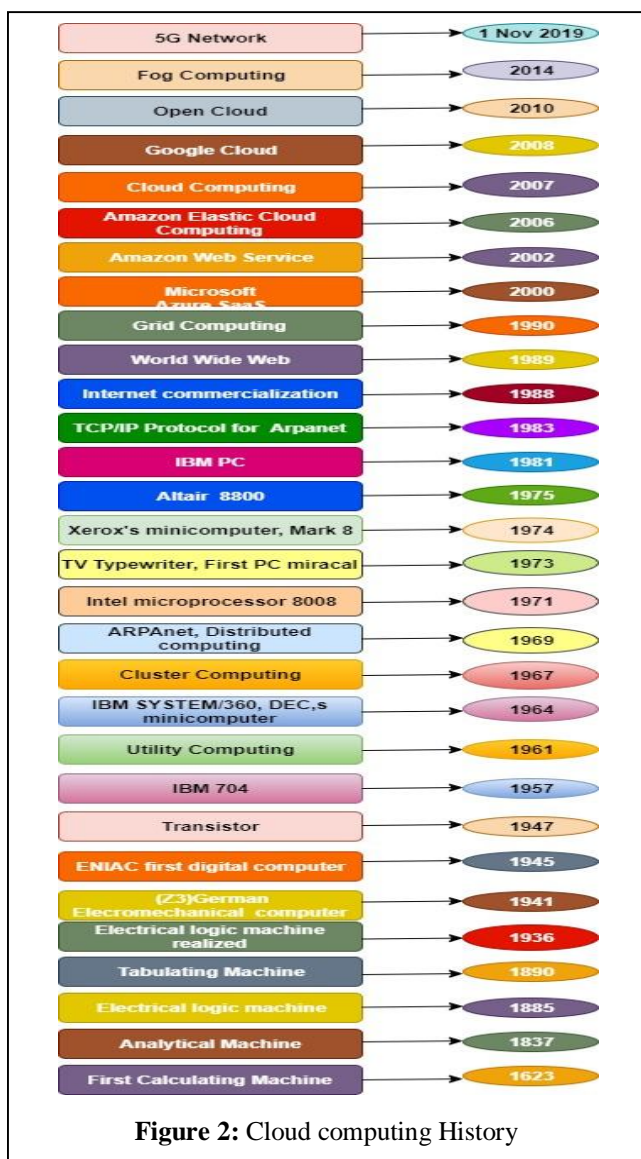
2.2 Cloud Computing History

Figure 2: Cloud computing History

In the 1960s J.C.R.licklider invented cloud computing from ARPANET [10]. Some times before to access the information and to use the resources a user required infrastructure and computer system at the same place as data storage. When cloud computing took birth, it changed the world with a strong backbone of virtualization [9]. Several scientists developed cloud computing technology, and Youseff et al. were the first to provide cloud computing and its mechanisms with an understanding of that. Cloud computing, they say, is a mixture of some old and new ideas [7]. Cloud computing is the mainstream technology of the existing technology and internet techniques. It began its journey with parallel computing after it came into being at Distributed [8], Utility, Cluster, Grid then Cloud Computing.

Now, we discuss the comparative study of various technologies of computing in Table 1. involved in a cloud computing evolution.

2.3 Cloud Computing Characteristics

National Institute of Standards and Technology (NIST) exposed five characteristics of cloud computing.

A. *Broad network access*

Resources always remain available over the internet user can use them globally through devices such as mobile, laptop desktop etc. [10].

B. *On demand self-service*

Consumer can access resources of computing like storage, application, CPU etc. whenever he wants without the interference of human being [8].

C. *Rapid elasticity*

Elasticity is the efficiency of expanding or shrinking the computing resources in real time, depending on the computing requirements of the consumer. Resources may be supplied despite of service provider involvement and may be swiftly scaled in or scale-out as needed by the user [4, 24].

D. *Resource pooling*

Computing resources from providers are pooled to assist all customers by a multi-tenant model, with various physical as well as VMs being dynamically allocated and reallocated allowing to user request [28].

E. *Measured service*

In cloud system services are provided as pay-per–use concept, so that cloud system observe and control automatically of utilized services by user and service provider.

There are some other characteristics found by some researchers.

Table 1: Comparative study of various technologies of computing [8, 10-16]

S. No.	Features	Distributed	Utility	Cluster	Grid	Cloud
1	Operating System	Windows or Linux	Linux through Windows and Solaris	Linux and Windows	No restriction is made on the OS.	Multiple OS can run
2	Number of servers	100s or 1000s	100s	100s	1000s	Varies from 100s to 1000s
3	System performance	Complex	Improves	Improves	Improves	Improves
4	Loose coupling	Yes	No	No	Both	Yes
5	Protocol/API	MPI and NFS		Parallel Virtual as well as MPI	GRAM, MPI, GIS and MPICHG	SOAP, REST and TCP/IP
6	Allocation	Decentralized	Centralized	Centralized	Decentralized	Centralized
7	Cost of switching	High	Low	Low	Low	High
8	Data locality exploited	Yes	No	No	No	Yes
9	Inexpensive	No	Yes	No	No	Yes
10	Business model	Yes	Yes	No	No	Yes
11	Service License Agreement (SLA)	Limited	Limited	Limited	Yes	Yes
12	Service Oriented Architecture (SOA)	Yes	Yes	No	Yes	Yes
13	Size of task	Small	Large	Single to large	Single to large	Small and medium
14	Population	Commodity computer and server	Commodity computer and server	Commodity computer	High end system (cluster server)	Power PCs, data connected to network of high-end servers
15	Ownership	Multiple	Single	Single	Multiple	Single
16	QoS guarantees	High support for best performance	Limited support	High support for best performance	Limited resources and often full effort	Limited assistance, geared towards availability
17	Virtualization	Yes	Half	Half	Half	Must required
18	Speed	Elevated bandwidth	Elevated bandwidth	Elevated bandwidth	Lower bandwidth	Elevated bandwidth
19	Scalability	Yes: The consumers and the resources	Yes	No	Half: sites as well as nodes	Yes: hardware, sites and nodes
20	Failures control	Limited control over failure management	Limited control over failure management	Limited control over failure management	Limited control over failure management	Strong failure management
21	Privacy	High Standard	Service Standard	Medium Standard	Medium Standard	High Standard
22	Security	Standard login based on password	Standard login based on password	Standard login based on password	Public / private key authentication based on pair	A virtual machine is provided for every user / program.
23	Transparency	Yes	Yes	Yes	No, Low	Yes, elevated but optional

24	Capability	Based on Product use	Based on a provision of service	Guarantee and Stable	Varies but high	Based upon a market specification
25	Resource management	Distributed	Distributed	Centralized	Decentralized organization and virtual organization	Centralized or delegable to third parties
26	Composition	Ideal PC and server	PC and server Specifications	Ideal PC	Servers to the high end	Ideal PC, Server and NAC
27	Product pricing	Limited	Pricing for utilities instead of flat rates	Not for open market but also limited	Dominated by private or public interest	Pricing of the utilities discounted for the larger clients.
28	Multi-tenancy	No	No	No	Yes	Yes
29	Reliability	Half	No	Less	Medium	High
30	User friendly	No	No	No	Half	Yes
31	Self service	No	No	No	Yes	Yes
32	Nodes' location	No need to be same physical location	No need to be same physical location	Physically in the same Location	Distributed overall the globe	Location does not matter
33	Homogeneous / heterogeneous	Homogenous	Heterogeneous	Homogeneous	Heterogeneous	Heterogeneous
34	Internet	Not required	Not required	No internet access	Yes internet required	Yes internet required
35	Interoperability	Yes	Yes	Yes	Yes	No
36	Application drivers	E-commerce including e-banking	Web hosting service, web app	Company, enterprise data centre computing	High-performance research collaboration	Web-app distribution of material, dynamic location
37	Service negotiation	Limited	Utility oriented and not flat	Not for open market but also limited	SLA based	SLA based
38	Application	Geographically dispersed	Business model	HP and,HTC	HPC, HTC and Batch	SME interactive apps
39	Example	www, peer to peer network, real time process control	Google, Amazon 2008	VAXcluster, ARCnet	SETI, GIMPS, Tera grid and NKN	Amazon EC2
40	Future	Cloud, Grid, Cluster and Utility computing	Cloud and Grid computing	Grid Computing	Cloud computing	Mobile as well as cloud computing for next generation

F. Unlimited storage

Cloud computing is a data storage model in which digital data is stored in the logical pool, cloud storage provider are responsible for keeping up the data accessible and available. People and organization buy or lease the storage as they need.

G. Flexibility

Cloud computing provides a flexible solution to the cloud users for data storage and accessing the resources any time anywhere over the internet using the mobile, computer and other devices.

H. Reliability

It provides the services 24/7 to users. User can take benefits of services from everywhere every time in the condition of the internet.

I. Inexpensive

As we recognize that cloud computing is wage as use model. User can be beneficial for renting the infrastructure form cloud provider. User does not need to worry of maintenance or extra charges of services.

J. Universality

Cloud computing is also called a ubiquitous computing because services are available all the time globally and any user can use services through the devices over the internet. Services which are available on the cloud are not custom make for a particular service. User can select a variety of application at the same time. Different user can run different applications at the same time.

2.4 Cloud Computing Service Models

There are some service models that provide the specific services to the customer as shown in Figure 3.

A. Software as a Service (SaaS)

This model is recognized as a software delivery model actually; it provides the license of the software applications to the users of cloud computing. Software applications can be used or accessible through the internet using the devices. Users do not require to maintain or installation of such application.
Example: Gmail, yahoo, Facebook etc. [21].

B. Platform as a Service (PaaS)

This model is commonly used by developers to develop their applications on the rental platform of cloud computing. It offers deployment of applications by reducing the cost of maintenance of hardware and software. SaaS only host completed cloud applications whether PaaS offers to complete the incomplete software.
Example: Google App Engine [8, 21].

C. Infrastructure as a Service (IaaS)

The model offers an overall cloud computing platform on the internet, meaning cloud users can set up their operating system and cloud provider control the memory, CPU and processing of the system. It offers a virtual server, storage, network hardware and operating system. Consumer pays only for consumed resources.
Example: Amazon Elastic Compute Cloud (EC2) [8, 21].

Some other types of service are more generally known as Anything as a Service (AaaS) being:

Figure 3: Service Model of Cloud Computing [35]
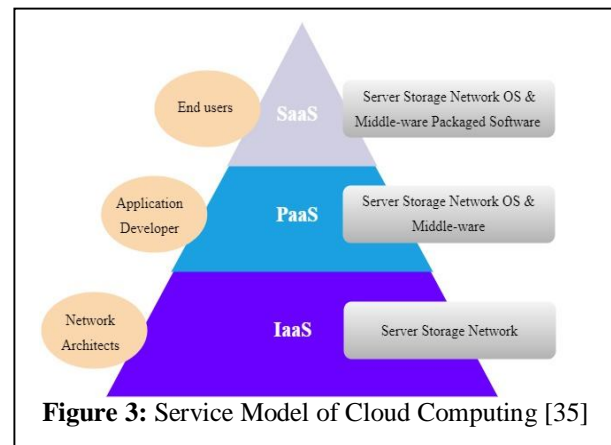
D. Function as a Service (FaaS)

Under the general term Server-less Computing, function as a service (FaaS) is associated, but the term may be used interchangeably. This model called service hosted a remote procedure call to enable individual functions to be deployed in the cloud running in response to events [22].

E. Mobile "backend" as a Service (BaaS)

BaaS has a mobile app and web app developers are serviced with a cloud storage solution to connect their devices to. Services provide customer monitoring, request confirmation, social networking incorporation and more [22].

F. Monitoring as a Service (MaaS)

This model monitors the state online of all the functionalities of services and applications, software, network, system and any element that deployed for users within the cloud. It provides the facility to users of state monitoring at different levels of cloud service.

G. Communication as a Service (CaaS)

CAAS is a solution for outsourced corporate communications that can be rented from a single supplier. These communications may include Instant Messaging (IM), Voice over IP (VoIP), applications for collaboration and video conferencing via fixed and mobile devices. The manufacturer of CAAS is responsible for all hardware and software operations and provides assured service quality (QoS). CAAS allows companies to selectively deploy devices and modes of communication on a pay-as-you-go concept, as needed [29].

H. Network as a Service (NaaS)

NAAS is a new model of cloud computing in which customers have access to additional computing resources with switch and router. NAAS may include elastic and comprehensive VPN (Virtual Private Network), protocols for multicast, bandwidth on-demand, security firewall, custom routing, detection and prevention of intrusion, content monitoring, filtering and antivirus.

2.5 Deployment Model of Cloud Computing

There are most popular and important models of cloud computing as depicted in Figure 4 and comparative study in Table 2.

A. Public Cloud

This model offers the services such as applications, software and storage to the users or any organization over the internet without any restriction to use them. Here services may be less secure, but users are free to use the services [8]. The infrastructure of a private model is made general public [21].

B. Private Cloud

Private clouds are called internal clouds. [6] The infrastructure of the private cloud is available only for specific authorized user or organization. Only internal user can use the resources. It is more secure then public cloud because only internal consumer can access the facilities. All the resources are maintained and govern by the organization itself [30, 10].

C. Hybrid Cloud

This cloud infrastructure is formed by a combining of public and private cloud that is called hybrid, private and public clouds are clutched within a standard protocol. This model provides pliancy more than public and private cloud and has a higher control over the applications in the infrastructure [6, 24].

D. Community Cloud

In this model, similar types of requirements of organizations share the infrastructure of community cloud. Using the resources commonly there is made a data centre by service provider where services are avail for the specific users and organization. This type of cloud is less expensive than private cloud and more secure [21, 11].

Figure 4: Deployment of Cloud Computing [36]
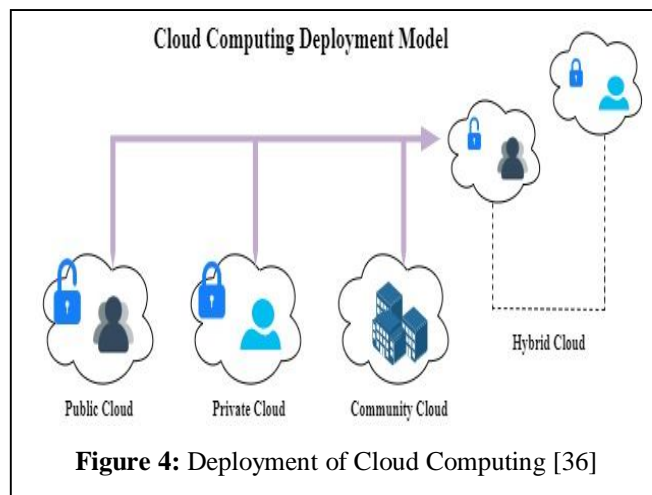
Table 2: Comparative study of Deployment Model [8, 10, 17].

Attributes	Public	Private	Community	Hybrid
Simple to install and use	Easy	Needs the IT expertise	Needs the IT expertise	Needs the IT expertise
Security and data protection	Low	High	High Comparatively to other	High
Controlling data	Little to none	High	High Comparatively to other	High Comparatively to other
Reliability	Susceptible	Extraordinary	Comparatively high	Extraordinary
Scalability and flexibility	Extraordinary	Extraordinary	Stable capacity	Extraordinary
Cost-efficiency	The lowest of those	The cost-intensive, the costliest	The costs are shared by members of the Community	Less expensive than a private model but more expensive than a public one
Request for Hardware in-house	No	Is based on	Is based on	Is based on
Workload	Suitable for control large workload nodes	Unsuitable for control large workload nodes	Suitable for control large workload nodes	Dynamic
Size of datacenter	Probably 50,000s	Probably 50,000s	Public cloud>15000> private cloud	Less than private cloud
Ownership	Owned by customers	Owned by single organization	Owned by two or more like-minded	It is partly owned by service providers

			organizations	and partly by customers
Virtualization	Optimization of resources via server virtualization	Optimization of resources via server virtualization	Efficiency of utilization by virtualization of servers	Optimization of resources via server virtualization
Maintenance cost	Lowest	Highest	Highest	Average
Accessibility	Unlimited	Limited access	Depends on no of cooperatives	Medium accessibility
Performance	Low /medium	Excellence	Very good	Good
Cloud bursting	Not supported	Not supported	Not supported	Supported
Example	Amazon EC2	Microsoft azure	Microsoft government community cloud	Rackspace hybrid cloud

2.6 Cloud Computing Benefits

Benefits of cloud computing is described here as follows:

A.   *Non Functional*

- Simplicity: user does not need deep knowledge to use cloud services.
- Reliability: There is a little bit chance of failure if fails recovery is so fast.
- Quality of services (QoS): it means services are provided best to satisfy the user's requirement.
- Availability: Services are available 24/7.
- Elasticity: resources can be accessed easily and modified as a requirement.
- Mobility: services are available on the internet so the user can access anywhere any time.

B.   *Economical*

- Cost Reduction: services of the cloud have cost reducible if the user doesn't need to buy or maintain expensive software.
- Pay per use: service provider charges only for used services.
- Green Environment: During the resources sharing it consumes the small amount of power to reduce the carbon emission.

C.   *Technological*

- Virtualization: Here, single physical resource works as multiple virtual resources. The single physical resource creates a multiple execution environments and abstracts its physical properties from other systems. Physical resources are as an operating system (OS), storage devices, network or server.
- Multi-tenancy: It means that multiple users can access the cloud resources at a time.
- Security and Privacy: Here, our data remains secure from unauthorized users.

- Data Management: in cloud computing our, data stored and managed in large amount by providing quick access.
- Tools: To setup the cloud environment many tools are implemented.

D.   *Cloud Provider's point of view*

Cloud provider says that recently all the existing data centers are underutilized. They are mostly 15-20% utilized. So large companies can take benefit by renting the rest to other companies and also make available all resources of the cloud for running data centre properly. A small type of business adopts this at very minimal cost.

E.   *Cloud User's point of view*

Here user says that the user does not require looking after of hardware and software what he uses and doesn't to worry about maintenance. Cloud consumers use demand-based resources and only pay for usage. Users are not long tied with the traditional system. User can switch easily.

2.7 Cloud Computing Challenges

A.   *Load Balancing*

Load balancing is a mechanism to stop the system failure. So it's a big challenge of cloud computing. In cloud computing infrastructure, when lots of demand for services hit on the server, then the system becomes overloaded. Load balancers distribute the load over all nodes equally to reduce the load to make the system smooth [34].

B.   *Performance*

According to the survey, performance is also a big problem in cloud computing. Healthy performance must be offered to the user when a user access cloud resources. Performance is measured by the overall efficiency of running applications on the system. Whenever a user wants more services from more the one cloud like as something from private cloud and something from hybrid or the pubic cloud, then it becomes a challenge to manage and serve the excellent performance of service.

C. Security

Cloud computing has dynamic scalability, virtualization and multi-tenancy features. Security is a big issue when data and applications move from one to another network. Various types of applications and data that move on the different servers so, it is difficult to address the security. [4, 24].

D. Interoperability

Interoperability means that the same rules are applicable on different cloud platforms. Cloud must have the flexibility of moving or switching whenever the user wants without the lock-in period for vendor. Here is found that lack of open principles, standard APIs and interfaces. It is the adoption resistance of cloud computing interoperability.

E. Migration

Migration is the time consuming issue, whenever a user wants to migrate from one cloud to another or one hosting facility provider has to aspect some other issues. It is not an informal task to move because in this process, work or business will stop for some hours/days [10].

F. Energy management

Energy is consumed [8] in cloud computing using the resources. Whenever high demand for resources of cloud computing then datacenters are unzipped in large amount which needs a big amount of power. But power consumption must be optimized for betterment.

Some other future issues, challenges and trends in cloud computing.

G. Internet of Things (IoT)

In cloud computing, IoT devices are definitely a potential phenomenon. IoT is a smart and intelligent technology where sensors are used. The IoT definition changes as the time of cloud computing comes "IoT= Cloud computing + Ubiquitous network + Intelligent sensing network" [25]. Making the atmosphere smart lots of use of sensors like a smart home guard, smart bulb, and smart switch everywhere. Putting up the sensors in various areas railway, bridge, electricity grid, oil, gas pipe and appliances etc. and then connect all the things with internet to operate the certain programs to realize the remote control.

H. 5G Network

There is huge amount of data produced through the various devices while handling this big data we need high speed of internet. This time IT organization looking forward to the high-speed network that is 5G. It is tested some in various palaces in the world. Data is kept in the cloud so that the cloud needs a high speed of the internet to adopt this data easily.

3. CLOUD COMPUTING ARCHITECTURE

The cloud computing architecture is divided into two ends. First one is a front end and the second one is the backend. The front end defines the users who interact to the internet for using the cloud resources. The back end defines the working in the cloud like hardware, software and applications, datacenters, security and management are operating internally user doesn't know of it.

Normally, cloud architecture is categorized into layers like infrastructure, platform, application, security and management layers as shown in Figure 5.

3.1 Application Layer

This layer has the real cloud applications. This layer has various features for automatic application scaling to accomplish better availability, efficiency and less operating expenses. Web services business applications and multimedia etc. are available on this layer.
Example: Google Apps, Facebook, YouTube.

3.2 Platform layer

This layer consists of an operating system and application framework to operate any application efficiently. It is like a framework that provides the environment and user can be burden-free to deploy the applications.
Example: Google's app engine works on this layer to offer storage implementation backing for the API [26].

3.3 Infrastructure layer

Another name of the infrastructure layer is a virtualization layer. This layer provides lots of storehouse and computing resources by sectioning the physical resources by virtualization. It is an essential part of the architecture of cloud computing. Some functions, such as a dynamic assignment of resources, are rendered only by virtualization technology.

3.4 Hardware layer

This layer is ideal for handling physical resources such as servers, switches, control and refrigeration systems. Exemplary hardware layers implemented in datacenters. Typically a data centre implants lots of servers that are clustered in frames and interrelated via routers and switches [26].

3.5 User/Client

A cloud client or user interacts to the internet for using the services from the cloud through the devices.
Example: Smartphone, personal computer, operating system and other devices etc.

Figure 5: Architecture of Cloud Computing
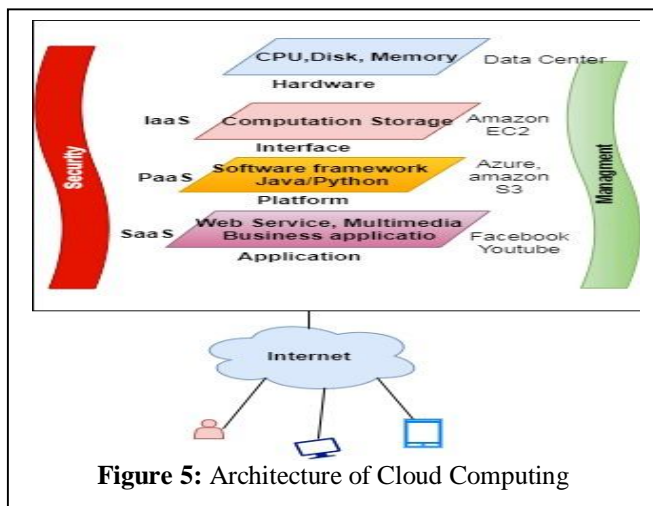
4. CLOUD COMPUTING TECHNOLOGIES AND PRODUCTION

We will describe a summary of the technologies used in cloud computing environments within this section.

4.1 Architectural Design of Data Centre

A data center covers lots of devices such as routers, switches and servers. The architecture design of the data centre is critical to find throughput and application performance in a distributed computing environment because of having a load of devices. Recently network architecture is design layered wise which had been established in some of the major datacenters. A simple layer of a data center is physically connected to the network where the server in racks is 20-40 servers per frame, each associated to a Gbps linked access switch. For redundancy of 10 Gbps connections, the access device connects typically to two aggregation switches [27]. The aggregation layer provides important functionalities such as managing server load, location service, domain service and more. The main routers handle traffic to and from the data centre.

4.2 Distributed File System over Cloud

The Google File System (GFS) [28], evolved in late 1990s, by using thousands of storehouse systems, designed from economically objective components to confer petabytes of storage to a large user community with diverse needs [28]. It was developed especially convenient access to data using large clusters of objective servers [26]. Files are separated into the small parts that are called chunks and size of these chunks is 64 megabytes. GFS is developed for high data throughput, minimum latency and persist individual failures.

HDFS (Hadoop Distributed File System) gained inspiration from GFS and started to store large files across multiple machines. The file system consists of a bunch of data nodes [26, 1], each of which uses HDFS-specific block protocol [1, 26, 29].

4.3 Distributed application frame work over Cloud

Distributed file system or applications over the network are working based on Hadoop and MapReduce concept. These both terms are mainly used in big data system analysing the large data. Hadoop is an open file system. Open source MapReduce and Hadoop project are used in companies to run large data-intensive calculations. MapReduce is a programmable framework for software [31] based on java language presented by Google [26] to backing a large data set of distributed computing.

5. POPULAR BUISNESS CLOUD APPS

In this part, we describe various business applications that for their availability and reliability are gaining popularity day by day. In the IT market, there are some providers, of them Amazon Cloud Compute (EC2), Windows Azure, Google App Engine etc. are the most popular.

5.1 Amazon S3 and EC2 Services

Amazon is finding as to the first largest organization which provides cloud computing services on a large scale. Amazon found some resources idle then decided that idle resources should be rented to the other organizations not physically but on the internet [32]. Amazon developed a series of web services such as Amazon EC2, [18], simple storage service (S3) [26]. Amazon Elastic compute [33] cloud enables cloud users' server size selecting the configurable virtual machine such as disk size, processor speed and RAM size. The user would have to generate the instance to imply his changes, so that uploading suitable software can make changes and after completing the changes it will be a bunch of new machines. This feature offers the capability to put instances in multiple places. These sites are made of sections and regions.

Amazon S3 is a storage service that provides proposal data security, high availability, and performance. It means that all the customers and companies can use the storage to protect the data from the malicious program such as mobile applications, websites, and backup and restore data, IoT devices and analysis of big data. Amazon S3 offers a concept that is convenient to use management features while a user can organize the data in finely tuned. Amazon S3 is calculated for 99.99% of stability and store data for billions of applications for industries in the whole world. [34].

5.2 Google-App-Engine

Google App Engine [18] is a cloud computing platform for managing web applications within Google's existing infrastructure. Use up to a predefined applicable resource is easy to scale, handle and safe. It also supports Java and python to the evolution of JVM languages. In 2008 the first version of Google App Engine [6] was introduced as beta [20].

5.3 Windows Azure

Windows Azure is a service for cloud computing that Microsoft creates to design, test, deploy and manage applications and services via Microsoft's managed data centre. This improves various distinguishing programming

frameworks, tools and languages [19] including applications and device unique to Microsoft and other parties [18].

Azure was initiated in Oct 2008 with the name "Project Red Dog" and in February 2010 came by the name "windows azure" [19].

6. CLOUD COMPUTING APPLICATIONS IN INDIAN CONTEXT

Cloud Computing can be used in rural areas for development for a best and easy life. If some applications are developed like as e-governance, e-banking etc. by using low-cost computing with best efficiency [37][38].

6.1 E- Governance

If the Indian government goes with the E-services that will be the big evolution. When all department of the government governed electronically, then all the services getting through the cloud computing than so there will not be charged extra, and this E-Governance would be the part of e-business. If E-Governance adopts technology, there are some impact such as 24/7 service model means that services availability high, regularly updated information supply, trained human resources security and privacy also monitored [18].

6.2 Rural developments

It is an interface between government and business organization. Main purpose is to improve the service providing to the public efficiently. Some projects should be initiated for facilitating to the villages like E-Gram Panchayat, E-management for Paradhan information and data updated on the website that should be connected wireless internet connectivity. Through this Internet connectivity, all rural citizens can be facilitated surfing the internet to find any update of the rural jobs, land information, and other information regarding village. [18].

6.3 Academic Libraries

Cloud Computing is used in libraries for best service and enhancement of their data without growing the cost value [4].

6.4 Biological research

Cloud computing provides lots of tool one of them Bioinformatics tools are used in biological research in small, very expenditure. And applications and datasets are also can be used for image analysis.

6.5 Document Processing

Now it is easy to convert of a very large bunch of documents from one form to another form of encryption of the data using the services of cloud computing [4].

6.6 Video Trans-coding

Cloud computing is used to transfer the video to audio and audio to video format easily. Example: AVI to MPEG [4].

6.7 Image Processing

Application of image-processing is used to converting the format like create thumbnails or enlarging an image [4].

6.8 Data mining

Data mining means a large collection of information and cloud computing has the capability to large processing in a mini moment [4].

6.9 Report generation

Cloud services can be utilized for generating the report like manufacturing, retailing and another economic sector. Insurance company healthcare organizations and institutions are working daily for the transaction for generating the report for billing [4].

6.10 Software Development

Keeping the records of software development cloud computing is used to check automatic and verify the software [4].

7. RECENT MOTIVATION TOWARDS CLOUD

Cloud computing is not a new concept, but it is a development In recent time, cloud computing prompts in business and personal work are noticed for facility owed to some up-to-date technology developments and commercial models [39].

7.1 Huge market for innovative application

Application which are more accurate for timely response and capable of deliver information by non-human radars finding are more popular. This type of applications are normally more involved to the cloud not only for high obtainability but also for more acute data and needed analysing of data there on different sources. [18]. More common are the transmission of information by non-human sensors or by other users.

7.2 Parallel batch processing

Implicitly cloud facilitates batch processing, as well as proficiently analyses terabyte data. Models such as Yahoo! open-source and Google's map-reduce same Hadoop's can be used to mask the organizational complexities of lots of servers for cloud computing in parallel processing [18].

7.3 New trend in entrepreneurship and science communities

This time business enterprises are excited to know the customer's need, the interest of the pattern to buy, and service management of providing to make the best decision for organization and supply. This type of online data processing can be done very easily with the aid of the cloud. User's requirement is personalized on the user's website or desktop after recognize. A big example of it is Yahoo!'s homepage [18].

7.4 Wide application for desktop

Which applications like Matlab, Mathematical are falling compute compact so that a single computer is not efficient to execute them? So these are made to be able to execute comprehensive appraisal using cloud computing [18].

8.   CONCLUSION

This study presented a systematic review of emerging technologies and developments in cloud computing. Cloud computing is on demand service which uses the pay per use concept to provide resources like computational platform, storage, servers. Cloud computing resources can contribute science and engineering scholars to use resources in demands, reduce cost of computing, improve research efficiency and provide better results. In this paper the deployment model and service model of cloud computing are also discussed, that helps in retrieving the information. We define the most popular business cloud applications in details and also applications of cloud computing based on Indian context are presented. Further, highlights the motivation towards cloud in recent time which helps the researchers to expand the knowledge of cloud computing.

REFERENCES

1.   I.A. Targio Hashem, I. Yaqoob, N.B. Anwar, S. Mokhtae , A. Gani and S.U. Khan "**The rise of big data on cloud computing: Review and research issues**", Elsevier Information System Vol. 47, No. C, pp 98-115, January 2015. https://dl.acm.org/doi/10.1016/j.is.2014.07.006

2.   K. Bilal, O. Khalid, A. Erbad and S.U. Khan **"Potential, trends and prospects in technologies: Fog, cloudlet, mobile edge and micro data centre**", Elsevier Computer Networks Vol. 130, No. 15 pp 94-120, January 2018.   DOI: https://doi.org/10.1016/j.comnet.2017.10.002

3.   W.Y.C. Wang, A. Rashid and H.M. Chuang "**Toward the trend of Cloud Computing"**, Journal of Electronic Commerce Research, VOL.12, No 4, pp 238-242, 2011.

4.   A. Jain and R. Kumar "**A Taxonomy of Cloud Computing**", International Journal of Scientific and Research Publications, Vol 4, Issue 7, pp. 1-5, July 214, ISSN 2250-3153.

5.   N. Choupra, T. Singh and A. Kumar "**Cloud Computing: A Review" International Journal of Computer Science and Technology** , Vol.3, Issue 3, PP. 65-68, July-Sept 2012.

6.   Q. Zhang, L. Cheng and R. Boutaba   "**Cloud Computing: state-of-the –art and research challenges**", 2014 IEEE 8th International Conference on Application of Information and Communication Technologies (AICT) , PP 7-18, 2015. DOI: 10.1109/ICAICT.2014.7035932

7.   R. Kour and A. Kour "**A Review paper on Evolution of Cloud Computing, its Approaches and Comparison with Grid Computing**", International Journal of Computer Science and Information Technologies, Vol.5 (5), pp. 6060-6063,2014.

8.   M. Haris and R. Z. Khan "**A Systematic Review of Cloud Computing**", International Journal of Computer Science and Engineering, Vol.6, Issue-11, pp. 632-639, Nov 2018.

9.   G. Mittal, N. Kesswani and K. Goswami "**A Survey of Current Trends in Distributed, Grid and Cloud Computing**" International Journal of Advance Studies in Computer Science and Engineering, Vol.2, Issue.3, pp. 1-6, 2013.

10.   M.O. Ahmad and R. Z. Khan "**The Cloud Computing: A Systematic Review**" International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Issue. 5, pp. 79-83, May 2015.

11.   N. Sadashiv and S.M.D. Kumar "**Cluster, Grid and Cloud Computing: A Detailed Comparison**" The 6th International Conference on Computer Science & Education (ICCSE 2011), pp. 477-482 August 3-5, 2011. SuperStar   Virgo,   Singapore. DOI:10.1109/ICCSE.2011.6028683

12.   I. Nwobodo, "**Cloud Computing: A Detailed Relationship to Grid and Cluster Computing**", International Journal of Future Computer and Communication, Vol. 4, No. 2, pp. 82-87, April 2015. doi: 10.7763/ijfcc.2015.v4.361

13.   A. Patel, A. Seyfi, Y.Tew and A. Jaradat "**Comparative study and review of Grid, Cloud, Utility Computing and Software as a Service for use by libraries**", Library Hi Tech News, No. 3, pp. 25-32, , 2011.

14.   H. AlHakami, H. Aldabbas and T. Alwada'n, "**Comparison between Cloud and Grid Computing: Review paper**", International Journal on Cloud Computing: Services and Architecture, Vol. 2, No. 4, pp. 1-21, August 2012. DOI: 10.5121/ijccsa.2012.2401

15.   "**Cloud Development models**", Retrieved from URL https://www.sam-solutions.com/blog/four-best-cloud-deployment-models-you-need-to-know/. Accessed in Nov 2019.

16.   A. Ghosh, "**Cloud Computing**", M.Tech Seminar Report, Department of Computer Science and Engineering, Indian Institute of Technology, Bombay, Powai   Mumbai. https://www.cse.iitb.ac.in/~abhirup09/Docs/cloud_computing_final_report.pdf

17.   "**Microsoft Azure Website**" Retrieved from URL https://en.wikipedia.org/wiki/Microsoft_Azure. Accessed Nov 2019.

18.   Retrieved   from   URL https://www.mkyong.com/tutorials/google-app-engine-tutorial/

19.   K. K. Lavania, Y. Sharma and C. Bakliwal "**A Review on Cloud Computing Model**", International Journal on Recent and Innovation Trends in Computing and Communication, Vol. 1, Issue. 3, pp.161-163, March 2013.

20.   Retrieved   from   URL https://en.wikipedia.org/wiki/Cloud_computing.

21.   https://www.bluepiit.com/blog/different-types-of-cloud-computing-service-models/.

22. M. Sajid and Z. Raza "**Cloud Computing: Issues and Challenges**", International Conference on Cloud, Big Data and Trust 2013, Nov 13-15, RGPV.
23. F. Tongke, "**Smart Agriculture Based on Cloud Computing and IOT**", Journal of Convergence Information Technology (JCIT), Vol. 8, No 2, Jan 2013 doi: 10.4156/jcit.vol8.issue2.26.
24. "**Datacentre Architecture**" Retrieved from URL https://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Data_Center/DC_Infra2_5/DCInfra_1.html, Accessed Nov 2019.
25. B. Dinesh and B.V. Mallu "**A Review on Cloud Computing**", International Journal of Engineering Trends and Technology, Vol. 4, Issue. 4, PP.803-808, April 2013.
26. "**Different types of Cloud Services**", Retrieved from URL https://www.bluepiit.com/blog/different-types-of-cloud-computing-service-models/, Accessed Oct 2019.
27. B. Singh, "**A systematic Review on Cloud Computing**" International Journal of Engineering Research &Technology, Vol. 2, Issue. 2, pp. 1-8, February 2013.
28. "**Distributed File System and Google file**", Retrieved from URL https://www.sciencedirect.com/topics/computer-science/google-file-system. Accessed Dce 2019.
29. "**Google File System**", Retrieved from URL https://www.sciencedirect.com/topics/computer-science/google-file-system. Accessed Oct 2019.
30. "**Hadoop and MapReduce**" Retrieved from URL https://www.tutorialspoint.com/hadoop/hadoop_mapreduce.html. Accessed Oct 2019.
31. S. Ma, "**A Review on Cloud Computing Development", Journal of Networks**, Vol.7, No.2, February 2012.
32. "**Amazon Elastic Cloud Compute**" Retrieved from URL https://en.wikipedia.org/wiki/Amazon_Elastic_Compute_Cloud. Accessed Nov 2019.
33. "**Amazon Simple Storage Services**" Retrieved from URL https://aws.amazon.com/s3/, Accessed Nov 2019.
34. M. Haris and R.Z. Khan "**A Systematic Review on Load Balancing Issues in Cloud Computing**" ICSCN 2019, LNDECT 39, pp. 297–303, 2020.
35. Retrieved from URL http://editsworld.com/cloud-computing-services-and-model/ accessed on 1:25 P.m, 27 Jan, 2020.
36. Retrieved from URL http://konstantinfosolutions.over-blog.com/cloud-deployment-models, accessed on 30 Jan, 2020.
37. A.A Altaye, J.S Nixon "**A Comparative Study on Big Data Applications in Higher Education**", WARSE, International journal of Emerging Trends in Engineering Research, Vol 7, No.12, pp. 739-745, December 2019. https://doi.org/10.30534/ijeter/2019/027122019
38. E.Chandra, P. Prederikus, S.Liu, G.Wang, " **Cukur 361 Mobile Application design for SME using Hadoop Framework**", WARSE, International Journal of Emerging Trends in Engineering Research, Vol 7, No 12, pp. 798-804. December 2019. https://doi.org/10.30534/ijeter/2019/127122019
39. B.W.K.Malubaya, G.Wang, "**Real Time Parking Information System with Cloud Computing Open Architecture Approach**", WARSE, International journal of Emerging Trends in Engineering Research, Vol 8, No 1, pp. 18-22. January 2020. https://doi.org/10.30534/ijeter/2020/04812020