

A COMPREHENSIVE STUDY ON CLOUD COMPUTING PARADIGM

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ABSTRACT

Cloud computing is regarded as massively scalable, an on-demand configurable resources computing model and is one of the latest topics in the information sector. It offers the cloud infrastructure in a distributed rather than dedicated infrastructure where clients can have full access to the scalable, reliable resources with high performance, everything is provided to the clients as a utility service over the internet. Data generated by IoT tagged objects is high, cloud is key to store the unpredictable data generated by these tagged devices and it is the forward stepped towards the green computing, it eliminates the setups and installation steps as the cloud client accessing the hardware resources co-exist on different platform in distributed way, Energy optimization, reduction in excessive heat and power consumption in cloud environment differentiates it from the traditional computing, which greatly proves to be the eco-friendly.

Keywords: Cloud Computing, On-demand, Distributed, Dedicated, Utility, Energy Optimization, Eco-friendly

I. INTRODUCTION

As the academic research is dynamic in nature, so the conceptual terms, frameworks and definitions are not finite, different authors put forward different opinions on cloud computing terminologies. Gartner's cited definition as Cloud computing is a style of computing where adaptable and versatile information technology-empowered capacities are given as an administration to numerous outside clients utilizing Internet advances. Cloud computing is a ubiquitous paradigm where everything offered to the cloud client is treated as service and it is regarded as a utility computing model which offers the wide range of services to the users on-demand bases in a distributed fashion, due to its versatility, agility both medium and large-scale emerging and developing technologies are adopting the cloud. As per the definition provided by the National Institute for Standards and Technology (NIST) "cloud computing is a model for enabling 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".

II. CLOUD COMPUTING EVOLUTION

Every entity that is being part of a system is having a definite evolution, As far as Cloud Computing is concerned, there is no exact date which mentions the evolution of it, However in 1960s, John McCarthy, Douglas Parkhill, and others explored the idea of computing as a public utility, because of the existence of

mainframe computers, during that period, the clients were accessing the central computing power through dummy terminals, which enable the clients to access the mainframe computer. With high cost and maintenance, it was not feasible for the organizations to buy these critical resources, and was the most challenging task for the big companies and organization to stay in the business market, and then there arose the concept of shared access to the single computing system in order to save the cost of buying separate machines. Evolution in Information Technology is not all of a sudden process rather it is a step-by-step transformation that brings a lot to cherish for organizations, companies. IBM launch the operating system in 1970 known as Virtual Machine (VM), this enabled the companies and organizations to run their operations on the operating systems simultaneously on more than one system with own memory and processing unit, VM became the initial phase towards the evolution of new technology known as Virtualization, collective collaboration of different computing platforms like Centralized, Parallel, Cluster, Distributed and Grid Computing gave birth of today's most talked computing paradigm known as Cloud Computing.

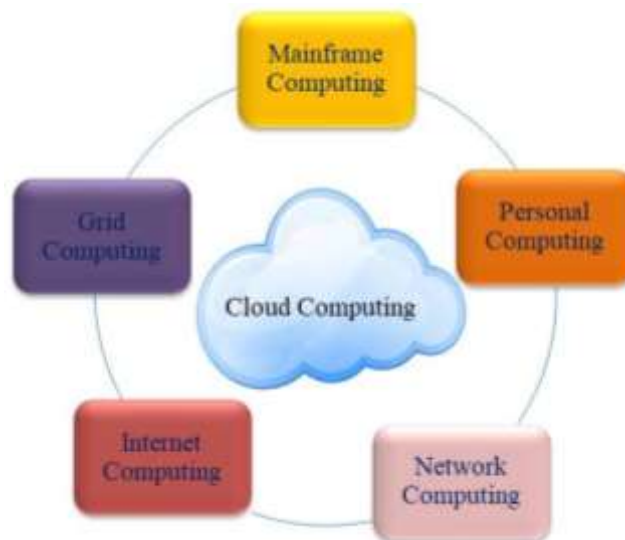


Figure.1 Cloud Computing Evolution

III. CLOUD SERVICE MODELS

- ✚ **Software-as-a-Service (SaaS):** It is a software distribution model where a third-party provider hosts applications and makes them available to customers over the high-speed internet connection.
- ✚ **Platform-as-a-Service (PaaS):** It is a middle layer which gives the organizations, institutions or companies a freedom and framework for developers to develop their own applications and deploy them and make customers within their company to access the resources.
- ✚ **Infrastructure-as-a-Service (IaaS):** Infrastructure is most vital among the three service models because it is the basic need to launch the organization's services over the internet in a cloud platform, to make their services available to clients and applications to run them smoothly.

IV.CLOUD COMPUTING DEPLOYMENT MODELS

- ✦ **Public Cloud:** The cloud services are easier to install and less expensive or even charge free, the applications, hardware and bandwidth are provided by the service provider, and are scalable, the user avail can only those services that they are interested.
- ✦ **Private Cloud:** As the name suggests, its services, infrastructure is solely operated and maintained by an organization. The services are made available on proper authentication, priority is being given towards the client's data security.
- ✦ **Community Cloud:** Here the cloud resources are shared by an organization which is of common interest for every participant which is being part of a community, whose needs are similar.
- ✦ **Hybrid Cloud:** It is a combination of two or more cloud deployment models like (public, private, community) it enables cloud application portability, multi-tenant, resource sharing.

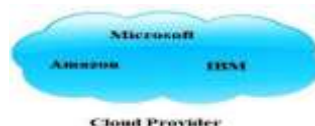
V.CLOUD COMPUTING CHARACTERISTICS

- ✦ **On-demand self-service:** A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically.
- ✦ **Measured service:** Public cloud providers like Amazon allow companies to avoid large upfront infrastructure investment, so the small companies can afford the workloads as per their requirement.
- ✦ **Broad network access:** Capabilities are available over the network that promotes use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).
- ✦ **Rapid elasticity:** Capabilities can be elastically provisioned and released, scale rapidly outward and inward commensurate with demand dynamically.
- ✦ **Resource pooling:** The resources like storage, servers, memory, Processing Unit, Network and virtual machines can be pooled and utilized by multi-tenant fashion with dynamically provisioning and de-provisioning of resources.

VI.NIST CLOUD COMPUTING ACTORS

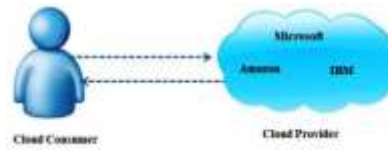
The NIST based reference model of cloud computing explains the major participants, their actions and functions, essentialities, uses, characteristics and standards of each participant in cloud paradigm. It defines five major actors in cloud architecture i.e. cloud consumer, cloud provider, cloud carrier, cloud auditor and cloud broker. Every individual participant is an entity that participates in any cloud-based transaction, processor, performs tasks in cloud computing. The architectural structure of cloud is the combination of the cloud services and deployment models with pre-defined essential characteristics of cloud reference model are given in the below-given cloud reference model. Some of the entities based on participation in cloud computing are as;

- ✦ **Cloud Provider:** An entity or an organization that plays role in making any cloud service available to the desired party.



- ✦ **Cloud Consumer:** An entity or an organization that is responsible

for maintaining a business relationship uses service from Cloud Providers.



- ✚ **Cloud Broker:** An entity responsible for the usage, performance and delivery of cloud services, facilitates relationships among the other participants.



- ✚ **Cloud Carrier:** It acts as an intermediary between Cloud Providers to Cloud Consumers, provides connectivity and transport of cloud services from.



- ✚ **Cloud Auditor:** An individual which can make independent assessment of cloud services, information system operations, performance and security of the cloud implementation



VII.WHY CLOUD COMPUTING

Cloud Computing is an internet network-based computing where the clients can access their resources remotely across the globe in a distributed manner, can upload and download the vital documents from cloud server and to their physical machine on the go with ease and comfort. What if, the social sites i.e. Facebook, Twitter, WhatsApp, Instagram, Snap chat, Wechat users on updating the statuses, photos, videos have to store them on their individual physical machines, another same case is about e-mails, balance sheets users have to store them on their personal computers and mobiles, what would be the possible scenario, simply will face storage limitations, So Cloud is the solution to this unfavorable situation as it offers them unlimited cloud-storage where they can store the information hassle free, As 24x& hours availability, Clients can access, make an updation or deletion of their resources with some web applications hence can manage the workloads

accordingly. Most of the companies, organizations, small or large scale industries are adopting the cloud as it an efficient way of computing and offers the more and more benefits. The cloud computing characteristics, provides the clients on demand services were clients are at their own will when to use and release the services, and can manage their resources with a remote access anytime from anywhere on the globe with high-speed bandwidth network, the pay as you grow feature of cloud is the most exciting one where only availed and used services are charged, clients can hold resources and any point of time can release them when no further needed.

- ✦ **Secure Storage Management:** the data stored and accessed over the cloud is being provided with the high secure authentication mechanism so that unauthorised emendation is not possible.
- ✦ **Pay as you Grow:** the rented service are liable to charge, the cloud client is at its ease to pay for only utilized services, can shrink and expand the resources as per the requirement.
- ✦ **Sustainability:** the sustainability the endurance of cloud environment is one of the exciting features, remain diverse and productive infinitely
- ✦ **Reliable:** cloud computing is a reliable computing paradigm where clouds can trust and rely on the services offered by cloud provides enormous services to cloud clients, as reliability is
- ✦ **Scalability:** resources can be scale-up and scale-down at any point in time because of the auto-scaling methods.
- ✦ **Utility Computing:** offers services and infrastructure are rented to the cloud client only when need and charges as per the services availed with efficient use of resources and minimize the costs.
- ✦ **Availability:** Cloud possesses the property of being available 24X7 hours. The availability feature makes cloud every organization their first choice to run the business. The e-commerce giants like Amazon, Flipkart, and Snapdeal etc. are dependent on the availability of cloud.

VIII.CLOUD COMPUTING ADVANTAGES

Cloud Computing is an attractive and exciting paradigm that comes with innumerable benefits, its flexibility, agility and advantageous features make it the first priority to adopt it. Some of the advantages are as;

- ✦ **Desirable Costs:** Using cloud it allows the cloud clients to avoid investing larger expenditure on the infrastructure like hardware and their up-gradation. It improves the cost efficiency of providing the choice and plan of utilizing the cloud services.
- ✦ **Flexible with Demand:** the demands are unpredictable, the cloud offers ease to cloud clients to avail the services like infrastructure, software and platform as the demand arises, in order to match up the required demands of users, Resources can be withdrawn any point of time when no more required.
- ✦ **Smooth Running of the Business:** Cloud provides the infrastructure 24x& and monitors it at the back end. Cloud maintains and monitors the infrastructure so that the client may not suffer. Keeps the data safe and secure so that the customer's business runs smoothly. The cloud service providers offer the flexible IT resources so that different project of a business unit can be deployed in a jiffy.

- ✦ **Enhanced security mechanism:** The survey reports conducted on cloud computing highlighted the security concern on the first priority. Security is the biggest challenge that cloud is facing, but with highly encrypted algorithms, the Cloud Customers can be worry free as the service providers provide the resiliency and agility at the infrastructure level in order to minimize the security risk factors, any fluctuation or compliance issues, the service providers handle it without the intervention of cloud users.
- ✦ **Energy-Efficient Paradigm:** Cloud computing is energy efficient as it offers the solutions which can protect our environment and save the deforestation and other unfriendly environmental activities, the cloud provides the online secure transactions which minimize the use of papers. Use the machines with less power consumption and are fewer heat exhalants, thus saves the energy.
- ✦ **Performance:** Most of the cloud service providers are giving attention towards the availability and neglecting the performance. It is a good idea for the companies to include the performance requirements in an SLA contract with a service provider, the companies have to keep regular checks on it and if any violation, should be brought in to the consideration for further improvement.
- ✦ **Scalable Storage:** The storage is no more a limitation when clients are using cloud platform and they don't have to buy now the blocky and costly hardware components like servers and storage devices etc. Scalability is the unique feature of cloud computing where dynamic provisioning of the resources is being done by the clients themselves within the real-time slice.
- ✦ **Software Compatibility:** Cloud providers typically support a specific set of software vendors and versions. A public cloud is a shared environment, where software is shared among hundreds or thousands of isolated customer environments. Software as service providers offers the compatible software to their customers in order to maintain the well-defined software standards.
- ✦ **Mobility:** Mobility provides the cloud with the "on the go" feature. It makes cloud easy to operate from anywhere on the globe and clients can access their applications and other resources from various devices like smartphones, tabs, desktops etc.
- ✦ **High-speed bandwidth:** As the cloud is related to the internet so in order to run smoothly and without the interrupts, high-speed bandwidth is more important. This feature can be achieved if and only if cloud service providers provide the clients with high-speed bandwidth, due to this high amount data can be transferred. As the networks are enhanced and improved the speed and bandwidth flaws are much better than ever before.
- ✦ **Backup and Disaster Recovery:** Gone are the days of tape back-up where clients used to store their vital data. The cloud vendors provide their clients platforms back up data, at any point in disastrous situations, the vendors offer them the ease to recover their lost data anytime.

IX.CLOUD COMPUTING LIMITATIONS

Since the use of the Internet connection to both applications and documents, so without a high-speed internet connection, access to the resources is not possible. Some of the limitations of cloud computing are as;

- ✦ Cloud computing cannot run without the internet connection.

- ✦ Lack of technical support, sometimes if cloud provider's server is unavailable, it can damage ones work progress.
- ✦ Slowness, unreliable Internet connection is not sufficient to access the cloud services.
- ✦ Accounts hacking is one of the worst scenarios of cloud computing.
- ✦ Malware violations are undetectable as the malicious software as a valid SaaS, once run these software harm and damage the cloud clients vital data.
- ✦ Data Breaching is also common in cloud computing which can be fatal in nature.
- ✦ Insecure API's, abuse of cloud services, denial of service attacks and insufficient diligence are some other flaws of Cloud Computing.
- ✦ QoS is the matter of concern as cloud offers tremendous advantageous features to their clients, but QoS is not maintained properly.

X. CONCLUSION

Cloud computing is an emerged trend as a combination of many already existing and computer technologies like the internet, networking, operating systems, hardware, software, middleware, virtualization, multi-tenancy, etc. On integration, it gets maximum utilization these technologies. It is finding the place in every aspect of life, it is empowering the business of small and large-scale companies, organizations, by providing them with the platform where they can run their services with fewer charges and get maximum benefits. As said, "two sides of a coin", cloud computing is having advantageous features but it also brings with it, lots of challenges, these challenges are proving to be disastrous, damaging the vital data the cloud service users. The data in Cloud Vendors Data-centers are very sensitive and need to be provided full proof security measures. Some of the exciting features like load balancing, scalability, and energy optimization are topics of much interest.

REFERENCES

- [1.] Nagaraju Kilari, "Cloud Computing - An Overview & Evolution", Cloud Computing - An Overview & Evolution, Vol 3, No. 1, 2018, pp.149-152
- [2.] Chetan M Bulla , Satish S Bhojannavar and Vishal M Danawade, "Cloud Computing: Research Activities and Challenges", International Journal of Emerging Trends & Technology in Computer Science, Vol 2, No. 5, 2013, pp.206-214
- [3.] Palvinder Singh, Er. Anurag Jain, "Survey Paper on Cloud Computing", International Journal of Innovations in Engineering and Technology, Vol 3 No. 4, 2014, pp.84-89
- [4.] Dimpi Rani, Rajiv Kumar Ranjan, "A Comparative Study of SaaS, PaaS and IaaS in Cloud Computing", A Comparative Study of SaaS, PaaS and IaaS in Cloud Computing, Vol 4, No. 6, June 2014, pp. 458-461
- [5.] H. R. Semsar, P. Daneshjoo, M. H. Rezvani, " Cloud Computing Security Solution Based on GRC Method and Fully Homomorphic Encryption Algorithm in a Private Cloud", International Journal of Science and Engineering Investigations, Vol 6, No. 69, 2017,pp.149-153

- [6.] Mr. Amol Kale, Dr. Rajivkumar Mente, “Impact of Cloud Computing on Education System”, International Journal of Electronics, Electrical and Computational System, Vol 6, No. 11, 2017, pp. 139-144
- [7.] R. M. Sharma, “ The Impact of Virtualization in Cloud Computing ”, International Journal of Recent Development in Engineering and Technology, Vol 3, No. 1, 2014, pp. 197-202
- [8.] Haibao CHEN, Song WU, Hai JIN, Wenguang CHEN, Jidong ZHAI, Yingwei LUO, Xiaolin WANG, “A survey of cloud resource management for complex engineering applications” Springer Link, Vol 10, No. 3, 2016, pp.447-461.
- [9.] Muhammad Aamir, Prof. Xiang Hong, Atif Ali Wagan, Muhammad Tahir, M. Asif, “Cloud Computing Security Challenges and their Compromised Attributes” International Journal of Scientific Engineering and Technology, Vol 3, No.4, 2014, pp. 395-399

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