Journal of Scientific and Technical Research
11 (1) June 2021, 43-47
http://www.publishingindia.com/jstr

Effective Utilization and Rising Challenges for Cloud Computing Environment during the COVID-19 Pandemic

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Abstract: This paper presents an overview of the Cloud Computing Environment and its deployment models. These service deployment models helped various industries to continue their functions. As COVID-19 pandemic has impacted the world like never before. This paper introduces COVID-19 and its severity also presents how cloud computing has given an alternative solution in the form of work from home. Cloud based applications, infrastructure, platforms, services and security provides the enriched solution to IT industries, healthcare sector, Educational Organizations and also to various other e-commerce platforms. This paper shows the effective techniques to utilize the various aspects provided by the cloud computing environment. It also raises the alarm for different security concerns in the deployment of Cloud platforms while COVID pandemic still exists among us.

Keywords: Cloud adaption, Cloud computing, Coronavirus, Data privacy, Work from home.

I. Introduction

COVID-19's, SARS-CoV-2, outbreak has compelled the people to stay in the home. It has affected almost everyone in various possible ways. It has caused the disruption all around. First noted case was found in Wuhan, China in December 2019 and spread around the world from the wet market of Wuhan. People suffered from the breathing discomfort, fever, body ache, diarrhea etc. and subsequently millions of the infected people lost their lives. Like other parts of the world India is also badly impacted due to COVID-19 cases and deaths. India is at the 2nd place in terms of COVID cases [1] [2]. It claimed number of lives during 1st and 2nd wave of the pandemic. World Health Organization (WHO) termed it as a Pandemic. Various safety instructions were issued by WHO and Government authorities to keep people safe from this pandemic. Some of the safety instructions are like social distancing, use of masks and frequent sanitization. Social distancing is been implemented by curtailing the gatherings, temporary banns on shopping centers and markets followed by the lockdowns in a number of phases. These social distancing measures forced the employees to stay at home and also forced the managements to find out a solution to keep-up the industries in its normal flow.

Managements identified the urgency and need of innovation and adaption. Apart from the IT industries, schools have been closed so there was also an urgent need of deploying it on online platforms and convert it into the virtual schools or in distance-learning. A number of businesses were shut down during the COVID-19 crisis and Cloud based technical solutions helped some of these struggling businesses and to some new business to flourish again.

Internet infrastructure and cloud computing and IT engineers played an important role to deploy the businesses solutions online. In section II it will be discussed categorically. But to just introduce here it can be seen the massive increase in traffics of Microsoft Teams, Zoom, Google Meet [3] etc. Increasing numbers of cloud farms are also indicating that there is an urgent need of Cloud Based Solutions. All the discussions, developments, testing like activities have been performed over these cloud-based environments. Education sector shifted online with massive use of ZOOM, MS Teams, Blackboard, Moodle, Google Meet etc. based platforms. All the related data like lecture notes, assignments, assessments, lecture deliveries are shifted to these motioned cloud-based platforms.

Global economics has witnessed the 1% decline during the COVID outbreak while it was projected increase of 2.5% before the outbreak. The net impact on global economy is now been estimated to 3.5% [5]. Indian economy is of $2.8 Trillion is also witnessing this surge of global market. It has impacted both large- and small-scale businesses. While markets are closed e-commerce giants like AMAZON, FLIPKART, MYNTRA, NYKAA, BIGGBASKET, ZOMATO and SWIGGY etc. has taken this outbreak and nationwide lockdown as opportunity and subsequently e-commerce business has performed really well during this difficult time.

Cloud computing has facilitated the advance digital infrastructure in ongoing COVID-19 pandemic. Cloud computing has provided solution to many domains like IT industries, Education industry, e-commerce, airline business, health care etc. [4]. Cloud computing delivers the computing services. It provides the storage, databases, severs, analytical skills and computing intelligence. It helps in rapid deployment, innovation, faster connectivity and economical solutions. Its benefits in Cost, Speed, Productivity, Performance, Reliability and security. Its global reach helps in ability to scale the elasticity.

II. Cloud Computing and its Models

Due to limited computation power and shortage of storage space the need of cloud computing came into existence. It provides solutions for hardware, software limitations as well [6]. It has proved cheaper than the conventional processing infrastructure. User can access data any-time at anyplace. Massive use of cloud computing has also increased in various structured, semi-structured and unstructured data. The increasing volume of the data can't be controlled using the traditional infrastructure. In that way cloud computing is providing the scalable solutions to the enterprise and to the users as well [7]. A cloud-based setup is made-up with a large number of users, cloud service providers, hardware and software infrastructure, high-speed internet infrastructure, service brokers, API's, scheduling algorithms and storage capability.

Cloud Computing is a technology that facilitates convenient, resource pooling, ubiquitous and on-demand access with abled service providers. Cloud enabled businesses witnessed the cost reduction for infrastructure setup [8]. Virtualization ensures the availability of infrastructure to the end user. Cloud Computing environment provide services like "plug and play" or "pay as you go". It provides users the freedom to choose platform, services, infrastructure as per their requirements.

There are several service delivery model and deployment models of cloud computing models. Cloud Service delivery models are as follows:

Infrastructure as a Service (IaaS): In cloud environments it virtually provides storage, power processing and networking like infrastructure to the user. By the year 2022 its projected market capture is $74.1 billion [9].

Platform as a Service (PaaS): It allows the user to deploy their own applications using the cloud platforms. It was having a market capture of $8615 billion in the year 2020 [9].

Software as a Service (SaaS): It allows the users to access the software through the cloud platforms. These products are administrated by the cloud service providers/vendors. Global market capture has reached to $157 billion in year 2020 [9].

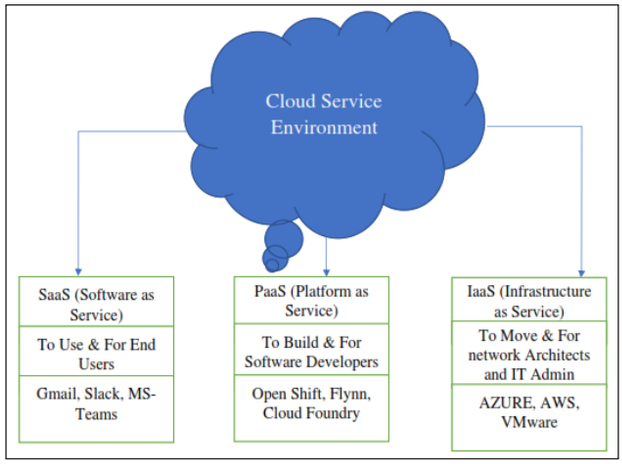

Fig. 1: Cloud Service Delivery Model

Apart from this Unified Communications-as-a-Service (UCaaS), Computing as a Service (CaaS), Security as a Service (also called as (SECaaS)) are also implemented to make this cloud computing environment more convenient. At cloud Server stack keeps user at the front end and server remains at the backend. While cloud services at the middleware.

Cloud deployment models are as follows:

Public Cloud: It is an unrestricted infrastructure to the users. It is owned by the IT industries; government bodies and they allow multiple stack holders to works simultaneously.

Private Cloud: It is used within the data centers of the organizations and all the authorized parties can access it.

Community Cloud: It allows to share the resources within a group organization at the same time.

Hybrid Cloud: It is collaboration of two or more cloud techniques.

III. Cloud Computing Components and Utilization during COVID-19

Cloud computing services are greatly used in COVID-19 pandemic. Its simplicity, scalability and elasticity of usage makes it easy to use [2]. During COVID-19, this technology has been utilized for data management, recording of information etc. If all the required components are arranged together then it can respond to all the intended functions. Let's categorically understand each component with example:

Cloud Clients: A set-up for the utilization of cloud services is known as the cloud client e.g., Android, iOS, Firefox, Chrome etc.

Cloud Services: It is designed for the product, services and solutions in real-time delivery e.g., Google Pay, PayPal, PayTM, Google Maps, OpenID etc.

Cloud Applications: These are software, accessed by the user by using the Internet. It is managed at servers only. Examples of Cloud platforms are like Facebook, Instagram, Torrent, salesforce.com, Blackboard Inc. etc.

Cloud Platforms: It is a service that has the access of both hardware and software like Kaggle, Google Collaboratory, Salesforce, Django etc.

Apart from these Cloud Storage and Cloud Infrastructure are very important components of the Cloud Computing Environments.

Here it is very important to understand the way cloud computing has been utilized during COVID-19. Here are the various categories in which Cloud Computing has been used and utilized effectively in during this pandemic.

- Storage as Service
- Database as Service
- Information as Service
- Process as Service
- Management as Service
- Testing as Service
- Infrastructure as Service
- Application as Service
- Platform as Service
- Integration as Service
- Security as Service

Application as Service has utilized the cloud service models and provided software like solution to the users. This software instantly connects with various cloud components and performs the action form the user's behalf. This software is installed in user's device and digitally accesses the records from the cloud servers [11] [12] [13]. These softwares utilize the resources to enhance the computation power of the user's cloud-based applications [14].

Cloud Computing provides a number of key features for the effective and trusted utilization of cloud-based services.

- Data Storage
- Cost
- Security
- Scalability
- Effective use of Artificial Intelligence

Since employees and managements are performing their regular tasks on cloud platforms using internet connectivity. Microsoft Teams has 250 million active users till Q3 2021. On an average 115-minute users are spending on this platform [15]. Zoom is way ahead of Microsoft teams having 350 million active users till December 2020 [16]. Other platforms like Slack, google meet and Discord are also contenting for their place. There are many infrastructures are available and users are using these platforms. A continuous belief in cloud based has been witnessed. In making of such trust systems these key features pay very important role.

Storage infrastructure is one of the key components that has been utilized majorly before and during the pandemic. Its low cost and "pay and go" business model impressed the audience. Cloud ensures the data security but there are some concerns in related to the data privacy. This will be detailed in the next section. So, use of the trusted cloud platforms is recommended. In case of the sharing of personal information over the untrusted cloud platforms may cause the breach in the security and the data can be leaked to the non-legitimate users. Cloud platforms are scalable and simultaneously using the various AI and machine learning based approaches to make this environment user friendly. Adaptive searches, personalized recommendations, analytical capabilities are helping in quick and effective decision making.

Challenges with Cloud Based Solutions

COVID-19 derived the word to transform digitally. It helped the businesses models like Business to Business, Business to Customer, Business to Government etc. During this pandemic these business models upgraded itself in Home to Business, Home to Government and Home to Customer business models. To curtail the spread of the virus people are living at home. Home is now work space to remotely perform the duties. This virtual connectivity helped employees and managements to work together. This virtual work culture has its own challenges. These challenges are as follows:

- Data Privacy
- Internet Infrastructure
- Personal Appliances

Data Privacy: We are living in an age where data is getting generated in abundance. During the pandemic users and data both increased enormously. Since Home to X has become the vital part of our lives. Users share their health care data, research data, personal information, educational materials etc. over some cloud platform using the internet infrastructure. People are bounded to share this data over these channels. Lack of regulatory authority causes the modification data without having method to track back the changes in data. It can be copied and published over the various public platforms. Data quality aspects like accuracy, completeness, redundancy and consistency. For these four aspects to be maintained again we need to have the regulatory body which have the solution to the grievances of the users. It's required to identify the jurisdiction in case of the loss of the data. Users don't have the information of the location where data is stored.

These platforms are also required to run over the Virtual Private Networks (VPNs). But there are a lot of malicious VPNs are available in that case Internet Security Protocols (IPsec) provides the trusted solutions to the Cloud based solutions.

Internet Infrastructure: COVID-19 has transformed the way we see the Internet. From being the need to be the fundamental right Internet has proved as solution to keep the continuous flow of the market. We have just discussed the massive increase in Internet users. Internet service providers (ISPs) have urgently understood this need to grow the infrastructure. Cloud Applications need a proper bandwidth to execute properly on user's device. In India 655 million active internet users which will grow 45% and will reach to 900 million by the year 2025 [18].

It is very challenging for the ISPs to maintain their high speed transmissions as there is huge surge in the traffic. Vodafone reported 50% surge in their traffic [19]. Various platforms cut down their bandwidth for uploading and downloading purposes e.g., Sony PlayStation, YouTube etc.

Packet loss in network reduces the efficiency. But intentional deployment of packet loss may avoid the network congestion and maintain the flow to the entire community [20].

Personal Appliances: During Work from home many people have start working with their own older devices and this imposes the security threat. These devices are requiring updates for its operating systems, anti-viruses and various other installed programs. It is easier for the attackers to exploit the loopholes of the older versions of the software. These devices may have some malware in this and they are not updated with the latest version of Operating System then it's possible that data maybe leaked to unauthorized people. When such outdated devices connect with the organization using the cloud platform then it may cause the leak of the sensitive information. This may cause the Distributed Denial of Service (DDOs) attack to the enterprise server and applications.

Apart from these Application issues must be noticed. These applications form must be tested for the bugs and various other validations tests. Applications should have a minimum requirement the user's machine and consume a significant amount of the bandwidth so that it can work effectively in non-favorable situations.

Cloud Computing Environments is distributed service-oriented. It is multi-domain, multi-user and multi-operating. It provides security against DDoS and EDoS attacks. Over provisioning in cloud resources causes the scarcity for the other devices. There are not enough resources available about the attacks in cloud computing environment.

IV. Conclusion

Cost effective services of cloud computing made it widely and readily available. It provides solution for IT industries, graphics design, education, banking, healthcare etc. COVID has transformed the workspace to work from home as a permanent solution. This reason in great increase in the volume of the data. Various service deployment model helps in accumulating the data shared between the various parties, provides interactive solutions and analytical capacity to the user but it has raised some alarms for the security of the cloud infrastructure. Cloud based services provides the edge to defend the challenge posed by the pandemic. Various security threats rose due to sudden unprecedented situation. So, these security challenges must be addressed. These challenges may be technical as well as the legal. There must be appointment of compliance officer to deal with such grievances. However, Cloud computing has enhanced the personal capacities and performances. Various industries are affected by the pandemic but cloud computing is showing the way to deal with challenges.

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