Date of Submission	25/04/2019
Date of Acceptance	07/06/2019
Date of Publication	30/06/2019
Page numbers	3146-3149(4 Pages)

EMERGING TECHNOLOGIES AND TRENDS IN CLOUD COMPUTING

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Abstract: With invent of IoT technologies, it is easier to connect people residing at geographically distant locations for information exchange. The ease in sharing of data across global boundaries has led to increased mooring of traffic for extracting services that are IT based. This has presented challenges before providers of these services to cope up with user expectations. Therefore, with emergence of cloud in the market, the models of fog and edge computing necessitates delivery of solutions that can cater heterogeneous user needs without constraints of latency and time-sensitive ser-vice delivery. It becomes imperative in such a scenario to offer viable solutions in the direction of provisioning security mechanisms to put a constraint on unauthorized user access to such services. Hence, technologies like multi-access edge computing (MEC) and cloudlet plays a vital role in comprehending security critical solutions. Therefore, the focus of this paper has been directed to discuss such emerging technologies pertaining to implementations in cloud that are capable of increasing confidence of user in distributed paradigm.

Keywords: Fog Computing, Edge Computing, Multi-access Edge Computing Cloud Computing, Internet of Things, Mobile Edge Computing and Cloudlet.

I. INTRODUCTION

Distributed systems are used to solve computational problems and the science which studies these systems is distributed computing. Distributed applications are the applications that are composed of a number of processes dedicated to solve any problem common to entire network across the globe. Scientific and Engineering problems are becoming more and more complex & users' needs have to be more accurate and precise solutions to their problems are required in shortest possible time. So, there comes the need of Grid computing. Grid Computing is a computing paradigm that has been fabricated to offer pervasive, dependable, consistent and cost effective access to capabilities that are computation intensive in a network. In order to acquire major characteristics like broad network access, On-demand self-service, pooling of resources, service measurement, elasticity and virtualization etc, the role of cloud computing comes into picture.

As it has been presented in research study conducted in [1], the metaphor cloud in computing terms is a model capable of offering on demand, network services to a shared pool of resources such as server, storage, networks, applications etc globally without much interaction among service providers or management efforts. Cloud service models are described as follows:

- SaaS applications are designed for end users and are delivered over the web.

- PaaS is the set of tools and services designed to make coding and deploying applications quickly and efficiently.
- IaaS is the hardware and software that powers it all servers, storage, network, operating systems.
- XaaS is a combination of Service-Oriented Infrastructure (SOI) and cloud computing. XaaS stands for "anything as a service" or "everything as a service". The services are provided over the Internet with a rapid increase in service offerings at global level.

In Accordance with National Institute of Science and Technology (NIST),Cloud computing is proficient enough in making services available to everyone connected to network [2]. It has been capable enough in making available the computing services, storage services and infrastructure pertaining to network in reach of the applications. Its biggest advantage is that the model of cloud works on pay per use principle to allow users to shared pool of resources on demand from anywhere. Many social web-sites like www.hotmail.com, www.amazon.com, www.facebook.com and linkedln.com etc. and search engines like Google and yahoo are utilizing the concept of cloud computing that is gaining a wide popularity from exploration to implementations of real time applications that are IoT based by providing numerous services [3] to end users like: Software as a service (Saas), Platform as a service (Paas), Resource Pooling, On-demand self-service, rapid elasticity and so on.

II. EMERGING TECHNOLOGIES

The emerging paradigm cloud is taking orientation towards mobile computing that simplifies the process further for the user as the operations are commuted via portable devices like laptops, tablets, mobile phones etc. Due to massive traffic, landing on cloud platform for acquisition of resources in form of services, the cloud is focused towards driving newer solutions that can offer greater flexibility to its users for their operations. Thus, the research work is oriented towards exploring newer technologies in cloud model and is as follows:

(i) Mobile cloud computing: Mobile cloud computing (MCC) has obtained its name from the two terms mobile computing and cloud computing when used in combination. It comprises of infrastructure that is capable of offering data processing and data storage services not just limited to users of smart phones rather inculcating a huge range of subscribers interested in extracting assorted cloud services [4]. The offerings of Cloud well establishes a synergy between various infrastructural platforms like mobile, IoT devices to provision CPU and data-intensive applications in IoT environments as extended by NIST [5]. Crowd sourcing, healthcare, sensor data processing and task of flooding are few applications of MCC [6].

(ii) Fog Computing: Though cloud computing is capable enough in its numerous service offerings, still it is finding challenges in copying up with huge heterogeneous graphic as traffic access to network due to congestion or other

similar difficulties. As a remedy the model implementers are trying to reduce the traffic sent over network by making services available near to the requesting devices. Hence the notion of Fog computing has been implemented in practice that is proficient enough in bridging the gap existing between bridges the gap between the IoT devices and cloud nodes. It realizes its implementation by provisioning storage, data management, computing and networking services to the nodes on network lying in the vicinity of IoT components. Fog Computing is defined by the Open Fog Consortium [7] as "a horizontal system level architecture that distributes computing, storage, control and networking functions closer to the users along a cloud-to-thing continuum." With these inventions Internet of Things (IoT) has included itself as a major component in human life and has led to a greater increase in count of devices aspiring to become the part of the network. Therefore, fog computing and other service offering paradigms seems to provide promising solutions to cater to the needs of security and time sensitive massive data communication.

(iii) Mobile ad hoc Cloud Computing: Mobile ad hoc Cloud Computing (MACC) is not meant for situations where there is a lack of centralized cloud [8]. With origination of adhoc mobile networks capable of formulation of temporary and dynamic network using routing mechanisms and protocols well versed with communication implementation procedures; it's been possible to extend the services to applications that are not much infrastructure-oriented. Such strategies are good enough in providing solutions to applications related to disaster management, vehicular movements, and group live video streaming etc.

(iv) Edge Computing: This computing is a subdivision of Fog Computing. It can be defined as a computing in which computation can be done at the edge of the connected network with the help of small data centres which are near to the users [8]. The main objective of this computing is to provide various storage resources available nearby to the users in an ubiquitous manner [9].

(v) Multi access Edge Computing: Use of mobile computing through edge computing is often referred to as Multi-access edge (MEC) computing. Multi access edge computing was known as "mobile edge computing," but this paradigm has now been expanded to include a wider range of applications like connected vehicles, health monitoring, video analytics, and augmented reality beyond mobile device-specific tasks.

(vi)Cloudlet Computing: Cloudlet computing was proposed by Carnegie Mellon University which shares many traits with MCC and MEC. In fact, it addresses some of the disadvantages of MCC. A cloudlet is a trusted resource-rich computer or a cluster of computers with strong connection to the Internet that is utilized by nearby mobile devices [10]. Cloudlets are small data centres called miniature clouds that are typically one hop away from mobile devices. The idea is to offload computation from mobile

devices to VM-based cloud-lets located on the network edge.

III. LATEST TRENDS IN CLOUD COMPUTING

Every year, new technologies emerge in cloud computing and change things in the business enterprise market. Cloud computing technology is the recent field and a game changer in today's era. Various are latest emerging trends in cloud computing.

(i) Artificial Intelligence: It is expected that artificial intelligence will be the latest hit in the cloud environment. Although AI enabled services are often used extensively but now AI will be required by voice commands as new user interfaces in the coming years. Specialized Decision Support System will drive AI adoption and will be accelerated by Alexa which is a product developed by Amazon which provides virtual assistant. It is capable of doing almost everything like playing music, preparing to-do lists, setting up alarms, voice interaction streaming podcasts, playing audios, and providing weather fore-cast, traffic, games, sports, and real time information[11]. Alexa can also monitor various smart devices like smart phones, smart watches using itself as a home automation system. Google home is the similar product offered by Google which is also home automation system and all other smart devices can be connected to it.

(ii) Security: With invent of new technologies, we generate a large amount of in-formation on regular basis in the era of big data, security breaching and data mining are the major issues of concerns. Data security and cloud security are gaining attention and many big companies are making regulations and policies in order to deal with security issues. The growing and continuous security breaches have forced government to drive new rules and regulations to take these cyber security and privacy concerns very seriously. Small scale and large scale industries and public and private sectors are enforced to follow Government norms and standards in order to ensure maintain integrity, availability of digital assets and confidentiality. Heavy penalties are imposed for non-compliance of these security breaches. Encryption and encoding are mandatory for better privacy at enterprise level. Due to all these factors, there is a tremendous demand for cloud security professionals who are working with AWS, Azure and Google Cloud Platforms. Proactive cloud security is another recent issue in which security systems are able to react dynamically to security threats attempts by the intruders. Now days, cloud providers understands that advancement in security features is the only key mechanisms to deal with such issues.

(iii) Rise of commercial cloud platforms: All the big players like Amazon Web Services, Microsoft Azure, IBM and Google witnessed a worldwide spike in the use of cloud platforms since 2017. Commercial cloud computing plat-forms have evolved well in terms of infrastructure services, business centric and data services. Being innovative and agile, there is a growing rise in these commercial cloud platforms. So, there is a lot of boom for aspiring cloud professionals.

(iv) More of Serverless or FaaS: Serverless computing, an extension of micro-services is an event based application design paradigm in which all necessary computing resources are offered as scalable cloud platforms. The emergence of serverless computing/architectures, built by cloud service providers like, Apache OpenWhisk, AWS, IBM, OpenWhisk and Google are the latest revolution. New features have been included in chatbot and machine learning services. With the emergence of leading candidate popularly known as Function-as-a-Service (FaaS) or serverless, the traditional platforms such as service (PaaS) and Infrastructure as a service (IaaS) are becoming more cost effective and flexible.

(v) Policy-based cloud resource governance: It is the next revolution in cloud. Governing agencies are keep on imposing rules and regulations on cloud-based resources like storage, compute and APIs etc [12].

(vi) Smart cloud management: Resource management, cloud performance management, billing management and Dynamic and automated responses to management-related tasks is related to smart cloud management.

As the volume of data continues to expand exponentially, there will be an increasing need to address this data in terms of security, format and quality. Organizations will be required to change their mindset and will need to be able to pull multiple data-streams together across multiple cloud environments into combined high-quality in-sights. Usage of cloud will be determined on the basis of ensuring that the data is stored in a controlled, managed, compliant environment [13]. This change will further contribute to future businesses that can use data stored in the cloud to provide predictive analytics for the business – such as predicting load requirements for peak shopping days, or market fluctuations to prepare investors [13].

VI. CONCLUSION AND FUTURE SCOPE

Since the emergence of the notion of distributed computing, the metaphor Cloud is emerging as the most preferred computing paradigm to deliver IT services to unanticipated heterogeneous traffic aspiring for services capable of complementing SLA and QoS requirements for customer and user satisfaction. The taxonomy of Cloud Computing is slowly and slowly inculcating in its implementation. Some emerging techniques like: Fog Computing, Edge, Multi-Access Edge Computing, Mobile Ad-hoc Cloud Computing and Cloudlet Computing for better services from service provider's perspectives and user service satisfaction parameters. The survey conducted in this research work presents a comprehensive study of

such emerging cloud platforms that are expected to uphold the market in coming decades in its entirety.

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