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Conceptualization of Cloud Computing and its Security Threats, Challenges, Technologies and Application

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Abstract: ***Cloud computing is the utilization of computer resources i.e. hardware and software which are delivered as service over a network. It delivers infrastructure, platform and software (applications) as services, which are made available to consumers. It is platform that offer high performance computation capability and managed by individual organization. Cloud provides use of virtualization technologies combine with self-service. In this paper we introduce different types of cloud computing deployment models and architecture. This paper describes the challenges in cloud computing and its security threats. Different types of cloud computing deployment models, viz. private, public, hybrid and community clouds are discussed. In this paper we also discussed the different technologies and its applications used for cloud computing.***
Keywords: Cloud computing, infrastructure, platform, software, virtualization, private, public, hybrid and community model

I. INTRODUCTION

Web – based email (Google or yahoo), social networking sites (Face book or LinkedIn), online cloud storage (drop box), online backup tool (Carbonite) etc are utilization of cloud computing in our daily life. Network or Internet can refer as cloud. Service over network is provided by Cloud i.e. public network or private network example LAN, WAN. E-mail, web conferencing, customer relationship management (CRM), is application of cloud which runs in cloud [1]. Manipulating, configuring, and accessing the applications online is called cloud computing. Data Storage and application are offer online. We can access the applications as utilities, over the internet [2]. Cloud is used as the medium to store massive amount of data of users. It is type of computing in which accessing and storing data on the internet rather storing on computer hard drive. It is less expensive because user doesn't need to purchase the whole system, they will pay as their use. Virtualization is a technique which is used behind it [3]. A cloud Computing is business model which offers its resources as service either on rental basis or pay as peruse [4].

II. DEPLOYMENT MODELS

Depending on the requirements of users, different deployment models are introduced as follow.

A. Public Cloud

The Cloud is available on commercial basis by a cloud service provider. For example Amazon EC2, Google App Engine, etc [5]

B. Private Cloud

The Cloud is maintained and operated by a specific organization and limits the access only to that particular group. It is more secure than public clouds because their users are trusted inside the organization. For example IBM cloud, Microsoft cloud etc [6].

C. Community Cloud

The cloud is shared among the different number of organizations which has the similar interest and requirements. Various state level government departments requiring access to the same data relating to roads, hospitals, use it for gathering information [7].

D. Hybrid Cloud

The Cloud is combination of at least two clouds. It can be private, public and community cloud. It helps business to take advantage of secured applications and data hosting on private cloud [8].

III. SERVICE MODELS

The Different deployed model in business model depending upon requirement of user is given below and diagram of service model

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is shown in Fig1.

A. Infrastructure as a Service (IaaS)

It is the base layer which deals with virtual machines, storage (Hard Disks), Servers, Network and Load balancers etc. This reduces the huge investment in computer hardware such as servers, networking devices and processing power [8][9].

B. Platform as a Service (PaaS)

It is the layer on the top of the Iaas. It is set of software or development tools hosted on the cloud provider's server. It provides all resources which are used to build applications and such services from the internet without installing or downloading any software on your PC. It is also known as cloud ware. Its includes design, development, testing, deployment and hosting and also provide other services like team collaboration, web service integration, database integration, security, scalability, storage and versioning. It helps to create user interface which is based upon HTML or java script [10][11].

C. Software as a Service (SaaS)

It is the Software distribution model in which the service providers hosted the applications on the cloud which is available to the customers over the network. The applications are like e-mail or other social networking sites (face book etc). There is no need to worry about installation, setup and running of application that the entire service provider will do for you. E.g.: Google Apps and Microsoft office, etc [12].

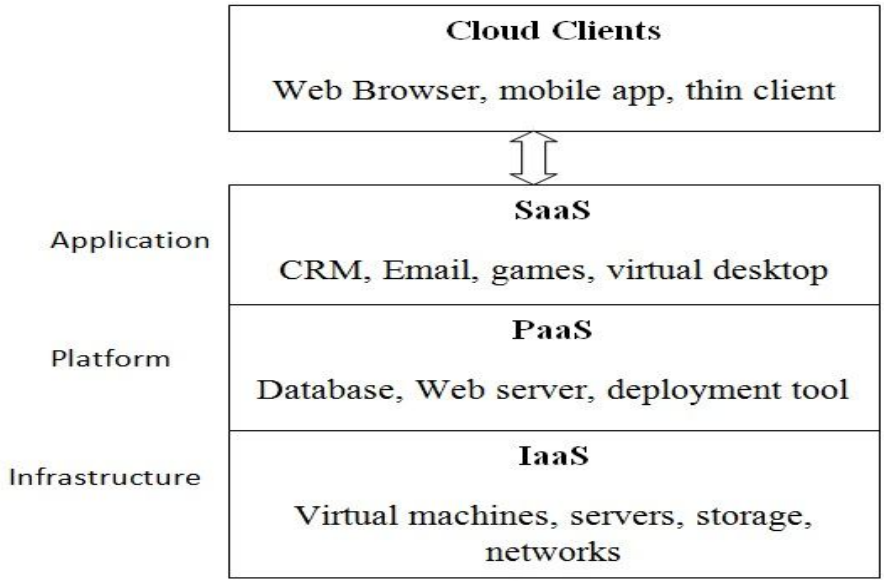

Fig1: Service Model diagram

IV. BENEFITS

It has many advantages. Some are listed below and Fig 2 show different benefits.

A. One can access applications as utilities, over the Internet [12].

B. Manipulate and configure the application online at any time [13].

C. It does not require installing a specific piece of software to access or manipulating cloud application [13].

D. Cloud Computing offers online development and deployment tools, programming runtime environment through Platform as a Service model [13].

E. Cloud resources are available over the network in a manner that provides platform independent access to any type of clients [14].

F. Cloud Computing offers on-demand self-service. The resources can be used without interaction with cloud service provider [13][14].

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G. Cloud Computing is highly cost effective because it operates at higher efficiencies with greater utilization. It just requires an Internet connection [14].

H. Cloud Computing offers load balancing that makes it more reliable [14].

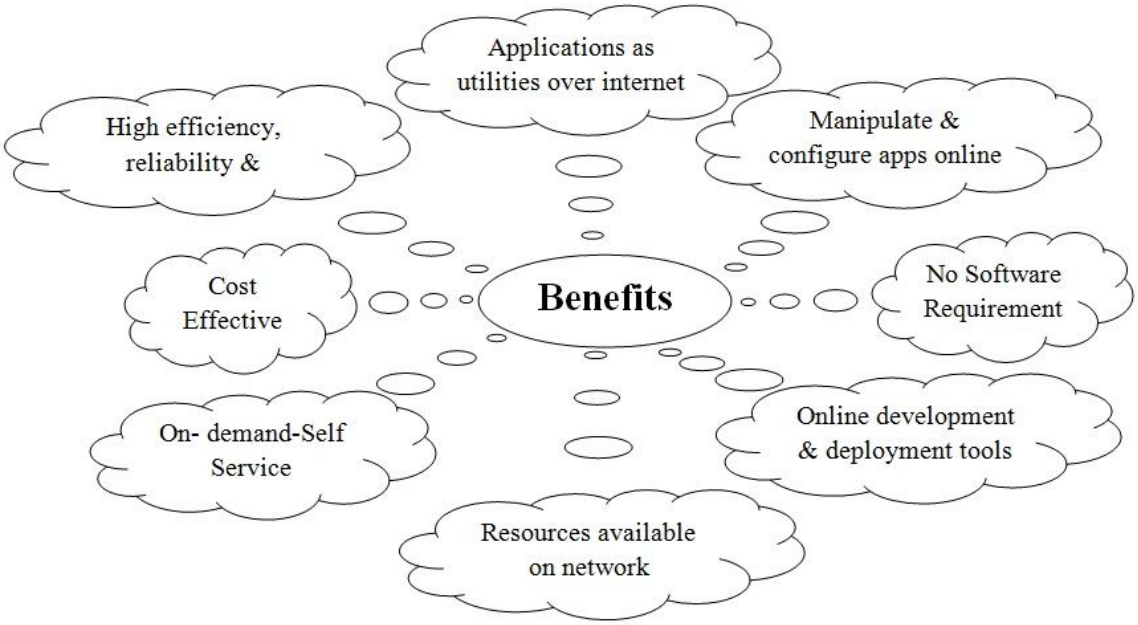

Fig2:Benefits

V. CLOUD COMPUTING CHALLENGES

Despite its growing influence, concerns regarding cloud computing still remain [14]. In our opinion, the benefits outweigh the drawbacks and the model is worth exploring. Some common challenges are:

A. Data Protection

Data Security is a crucial element that warrants scrutiny. Enterprises are reluctant to buy an assurance of business data security from vendors [15]. They fear losing data to competition and the data confidentiality of consumers. In many instances, the actual storage location is not disclosed, adding onto the security concerns of enterprises. In the existing models, firewalls across data centers (owned by enterprises) protect this sensitive information. In the cloud model, Service providers are responsible for maintaining data security and enterprises would have to rely on them.

B. Data Recovery and Availability

All business applications have Service level agreements that are stringently followed [16]. Operational teams play a key role in management of service level agreements and runtime governance of applications. In production environments, operational teams support.

1) Appropriate clustering and Fail over
2) Data Replication
3) System monitoring (Transactions monitoring, logs monitoring and others)
4) Maintenance (Runtime Governance)
5) Disaster recovery
6) Capacity and performance management

C. Management Capabilities

Despite there being multiple cloud providers, the management of platform and infrastructure is still in its infancy [17]. Features like, Auto-scaling‟ for example, is a crucial requirement for many enterprises. There is huge potential to improve on the scalability and load balancing features provided today [18].

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D. Regulatory and Compliance Restrictions

In some of the European countries, Government regulations do not allow customer's personal information and other sensitive information to be physically located outside the state or country [19]. In order to meet such requirements, cloud providers need to setup a data center or a storage site exclusively within the country to comply with regulations. Having such an infrastructure may not always be feasible and is a big challenge for cloud providers [20]. With cloud computing, the action moves to the interface — that is, to the interface between service suppliers and multiple groups of service consumers. Cloud services will demand expertise in distributed services, procurement, risk assessment and service negotiation — areas that many enterprises are only modestly equipped to handle [21].

VI. CLOUD COMPUTING TECHNOLOGIES

A. Virtualization

It is a technique, which allows sharing single physical instance of an application or resource among multiple organizations or tenants (customers). It does so by assigning a logical name to a physical resource and providing a pointer to that physical resource when demanded. The **Multitenant** architecture offers **virtual isolation** among the multiple tenants and therefore the organizations can use and customize the application as though they each have its own instance running. Fig3 show virtual cloud model [22].

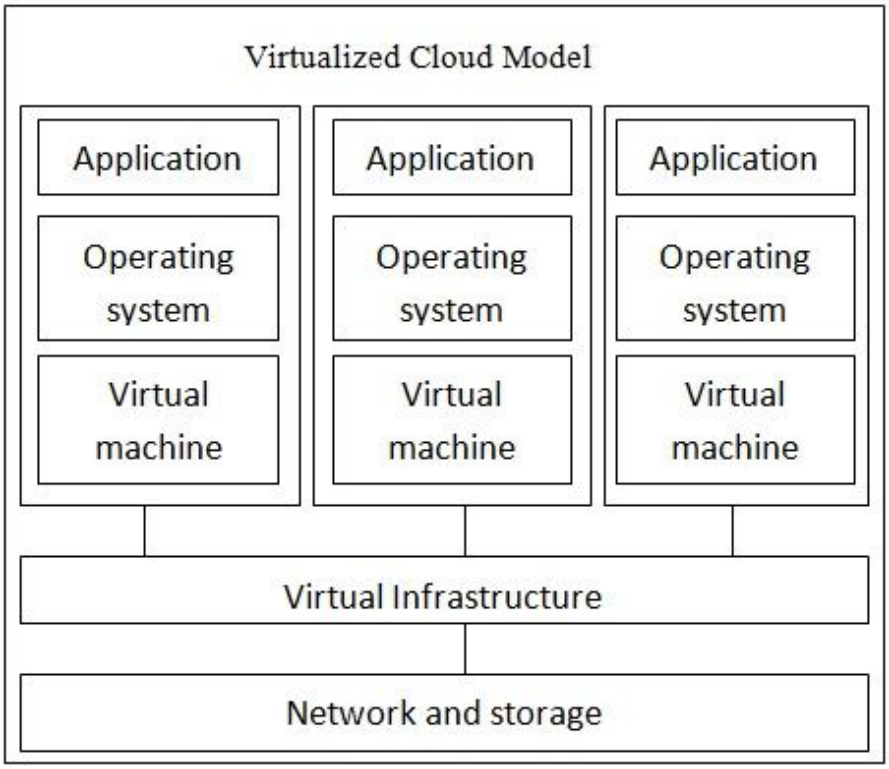

Fig3: Virtual Cloud Model

B. Service-Oriented Architecture (SOA)

Service-Oriented Architecture helps to use applications as a service for other applications regardless the type of vendor, product or technology. Therefore, it is possible to exchange of data between applications of different vendors without additional programming or making changes to services [23].

C. Grid Computing

Grid Computing refers to distributed computing in which a group of computers from multiple locations are connected with each other to achieve common objective. These computer resources are heterogeneous and geographically dispersed. Grid Computing

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breaks complex task into smaller pieces. These smaller pieces are distributed to CPUs that reside within the grid [24].

D. Utility Computing

Utility computing is based on Pay per Use model. It offers computational resources on demand as a metered service. Cloud computing, grid computing, and managed IT services are based on the concept of utility computing [25].

VII. CLOUD COMPUTING ARCHITECTURE

Cloud Computing architecture comprises of many cloud components, each of them are loosely coupled. We can broadly divide the cloud architecture into two parts and its architecture is show in Fig 4.

A. Front End

Front End refers to the client part of cloud computing system. It consists of interfaces and applications that are required to access the cloud computing platforms, e.g., Web Browser [25] [26].

B. Back End

Back End refers to the cloud itself. It consists of all the resources required to provide cloud computing services. It comprises of huge data storage, virtual machines, security mechanism, services, deployment models, servers, etc [26].

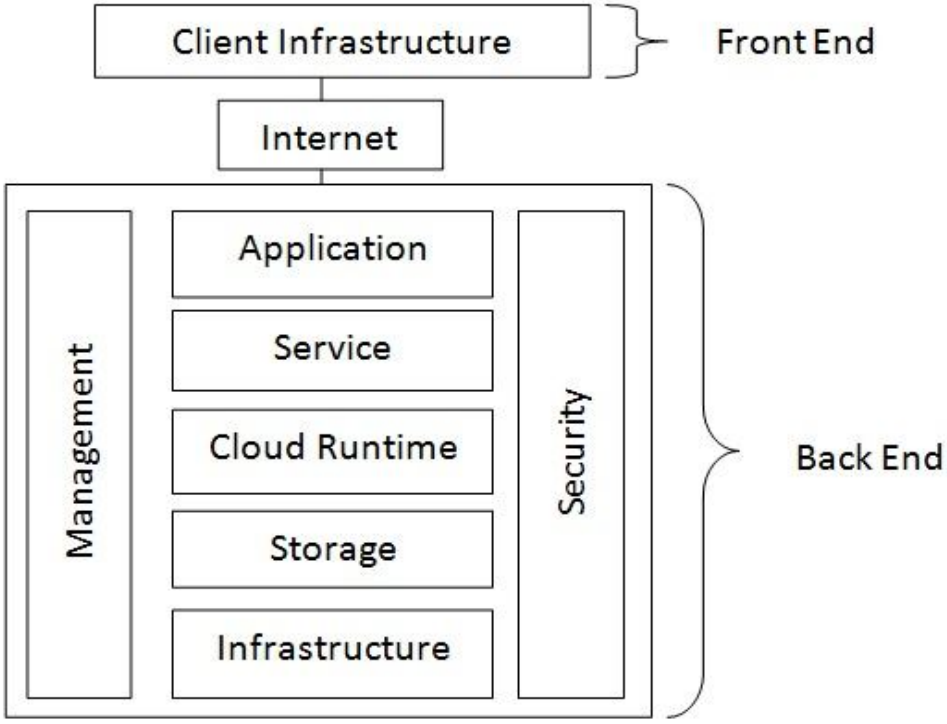

Fig4: Cloud Computing Architecture

VIII. SECURITY THREATS IN CLOUD COMPUTING

There is need to explore security threats so that security can be made to protect the cloud environment [30] [31]. The security threats in the cloud computing are as follow:

A. Abuse and Unauthorized use of Cloud Computing

Iaas provides the customers with unlimited compute of network and storage capacity with easy registration process and anyone can easily access the cloud [27].

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B. Data Loss or Data leakage: Deletion or alteration of records, loss of encoding key may results in effective destruction.

C. Unknown Risk Profile

The features and the functionalities of cloud service are to be well advertised. The incomplete information to the customers with an unknown risk profile leads to the security threats [28].

D. Insecure Interfaces and API

All the provisioning, management, monitoring is done by using these interfaces. The security of cloud is depending upon the basic APIs [33].

E. Malicious Insiders

The malicious insiders are the well known threat to most of the organizations. This threat occurs with lack of transparency on provider process and procedure in the single management domain of the organization [29].

F. Shared Technology Issues

The attackers target the shared technology in the cloud computing [32][33].

G. Account or Service Hijacking

This type of threat is done by the techniques called phishing, fraud, exploitation of software vulnerabilities where the hackers used to steal the credentials [30].

IX. APPLICATION OF CLOUD COMPUTING

Because of online sharing resources, cloud computing has become an important part of computing. The application of cloud computing is shown in the following fields as follows:

A. E-Learning

In the field of education that provides an attractive environment for students, faculty members, and researchers. Students, faculty members, researcher can connect to the cloud of their organization and access data and information from there [34].

B. Enterprise Resource Planning (ERP)

Use of Cloud in ERP comes into existence when the business of any organization grows. The work of managing applications, human resources, payroll etc becomes expensive and complex. To overcome it service providers can install ERP in the cloud itself [34].

C. E- Governance

Cloud Computing can improve the functioning of a government by improving the way it provides the services to its citizens, institutions and cooperation with other governments [34].

X. CONCLUSION

Cloud computing has playing a major role in the IT business to reduce operational costs and optimizing through various techniques. It is widely used technology providing much type of services to customers online. It provides the network based access to commercially available software. The data on cloud can be accessed anytime and from anywhere on cloud. The decentralized behavior that transferring of data in the cloud involves the security issues in the cloud environments. Security is the most important issue in the cloud computing, thus the certain security protection mechanisms are made to protect the data on the cloud. Cloud Computing provides a promising infrastructure for executing scientific distributed applications. The different benefit of cloud computing proves that it is most important part of computing. Different technologies are discussed to access cloud and various challenges it has to deal with are mention. Enterprise resource planning, E-governance and E-learning are the main applications of cloud computing.

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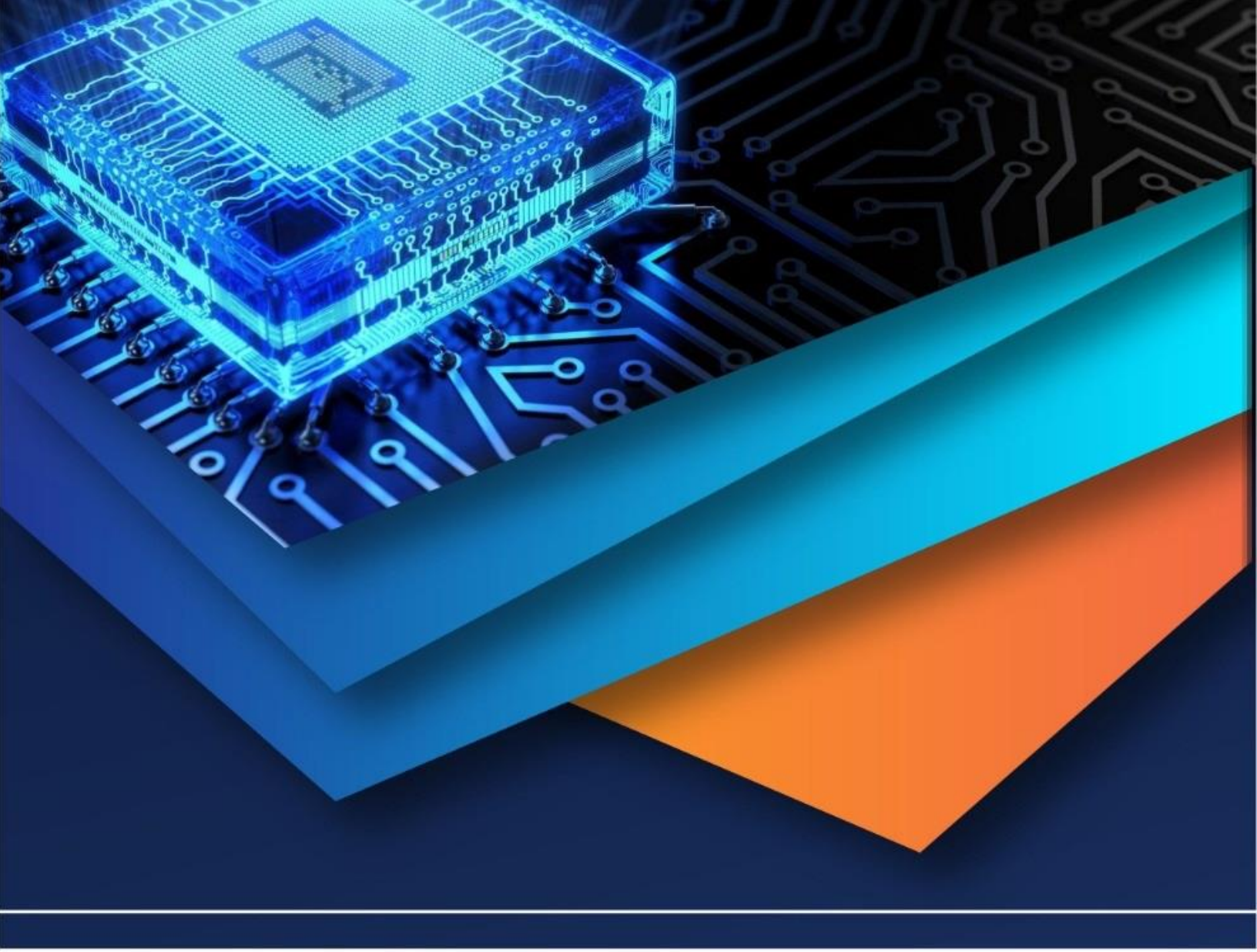

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