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Virtualization and Security in Cloud Computing

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Abstract: Cloud Computing is becoming an integral part of Next generation technology & becoming up business and IT industry. It is the fastest growing technology nowadays cloud servers work on the technology that provides services on the demand to the users. Virtualization enhance resource availability helps to overcome the problems of Data loss, access & data security. This paper focuses on impact of virtualization technique, how it helps to expand the flexibility of resources in cloud environment, security threats and ways to tackle them components of virtualization, its types, hypervisor & application architecture that provides energy overhead, sustainability & usability of cloud virtualization.

I. INTRODUCTION

Over the year, IT technological uprise has brought up with a new lifestyle of people. Cloud computing technological innovation is one of them, Use of cloud servers has greatly increased because of its flexibility resources availability and per use way approach. A typical data for cloud computing would consist of thousands of servers & hundreds of thousands of hierarchically connected switches.

According to studies reveal that Ideal system uses about 70% of energy. In order to reduces energy consumption & reach environment sustainability, application of virtualization technology in cloud computing is gathering momentum. The concept was firstly introduced in 1960 by IBM to provide concurrent, interaction access to main frame computer-IBM-360 which support many instances of OS running of same computer hardware platform. Now this technology innovation has gained momentum in its use by providing hardware independence cost saving, improved management, encapsulation & isolation.

By the sharing computing resource through service provided by virtual machine, users can reduce the cost of hardware software. Virtual machine are utilized for providing service which can result high resource utilization, easy system upgrade & maintenance. This research describe new trends in achieving data networking centre for cloud computing & well as challenges in its attainment.

II. CLOUD COMPUTING

Cloud Computing is a frequent that we come across in IT, business and other related field. Generally, Cloud computing is a technology that can maintain data & application and across users to access their personal files and Data at any computers with internet access & a central remote servers. The technology allows efficient storage, processing & delivers hosted service over the internet.

Cloud Computing offers reduced hardware maintenance & cost effective on demand service to users, without the need for large up scale front infrastructure investment. Basically, this technology can bring benefits to service provides as well as service users for service providers, they can service users, they don't have to worry about hardware & software maintenance & upgradation & pay on demand . Apple, Google, Microsoft, etc are the biggest cloud service provides that provide huge service & storage to there user.

Background of Cloud Computing - History of Cloud Computing can be dated back to 1960s when John McCarthy wrote that "Computation may someday be organized as Publication ".

The term cloud computing was first used by Ramnath Chellapa during in 1997. In 1999, Salesforce.com which was one a the first movers in cloud computing introduced the concept of delivering enterprise application via a simple website.

Since then, different companies followed up to emergence of this technology like Amazon in 2002 launched Amazon webservice, then Google Docs & Amazon's Elastic compute cloud (EC2) as commercial web service in 2006. Next follow up that enhanced cloud computing to another level was collaboration between IBM & Google in 2007 Eucalyptus in 2008, followed by open Nebula, Microsoft in 2009 with Windows Azure. Currently Cloud Computing has become a main target for different software & IT Companies.

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A. Basics of Cloud Computing Model

Cloud Computing is based on resource availability to users as well as low cost software.

Essential Characteristics of cloud Model as defined by NIST (National Institute Of Standard & Technology, US Department of Commerce) includes

1) On Demand self Service
2) Resource Pooling (Location Independent)
3) Broad Network Access / Ubiquitous network
4) Rapid Elasticity
5) Measured Service / Pay per us.

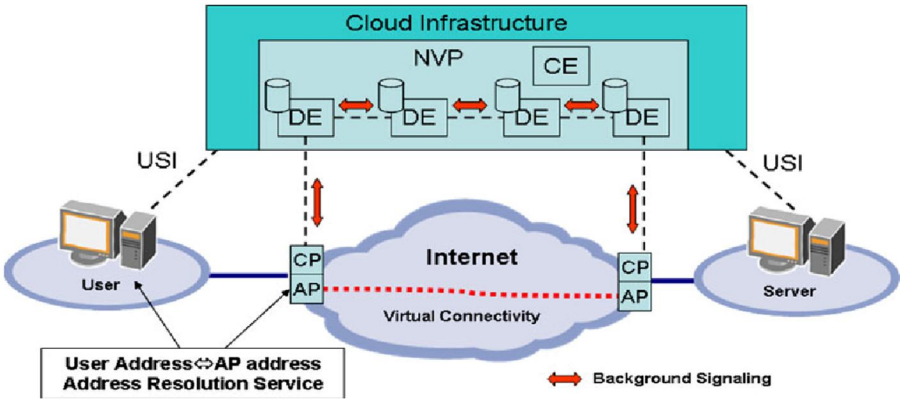

Fig. 1 Cloud Computing Model

III. SERVICE MODEL

Typically, there are 3 level of Service provided by cloud provide & ranging from the lowest types infrastructure which build up via platform & then software as services.

A. Software as a Service (SaaS)

Maintenance, update, deployment & security is provided and handled by service provider through their Administration control. So they consumers can fully enjoy their service without any hassles. Example Gmail, Salesforce's, CRM, etc.

B. Platform as a Service(PaaS)

Users can build their own application that run on provider's infrastructure that support transactions, uniform, authentication, robust stability & availability. The entire life cycle can be operated here like Google Apps Engine, Microsoft Windows Azure.

C. Infrastructure as a Service (IaaS)

Where provider rent their virtual computers, cloud storage , even give CPU clocks with OS level control to the developers. Example Amazon EC2, Google computer Engine, etc. Amazon is the pioneer of IaaS.

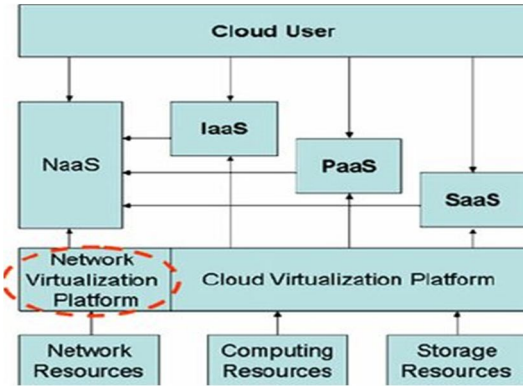

Fig. 2 Cloud Server

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IV. DEPLOYMENT MODELS

1) *Private Cloud:* Only operated for an Organization.
2) *Public Cloud:* Made for General Public or large industry group.
3) *Hybrid:* Compositor of two or more cloud, unique entries.

V. WHAT IS VIRTUALIZATION

In General terms. Virtualization is defined as making virtual version rather than actual version of something such OS, a server, application, Storage, device, or network resources. Virtualization is the transforming the basic way of computing with its wide range of OS, server , application & Hardware level virtualization. The main goal of the virtualization cloud computing technology is to make computing more approachable & flexible by transforming traditional computing in an efficient way.

A. Need of Virtualization

Virtualization application would provides benefit that might not be possible using cloud computing alone virtualization provide features such as-

1) Centrally Manageable
2) No need of Installed
3) Supply on Demand
4) Availability
5) Multitenancy
6) Hardware Utilization
7) Maximized Resources.

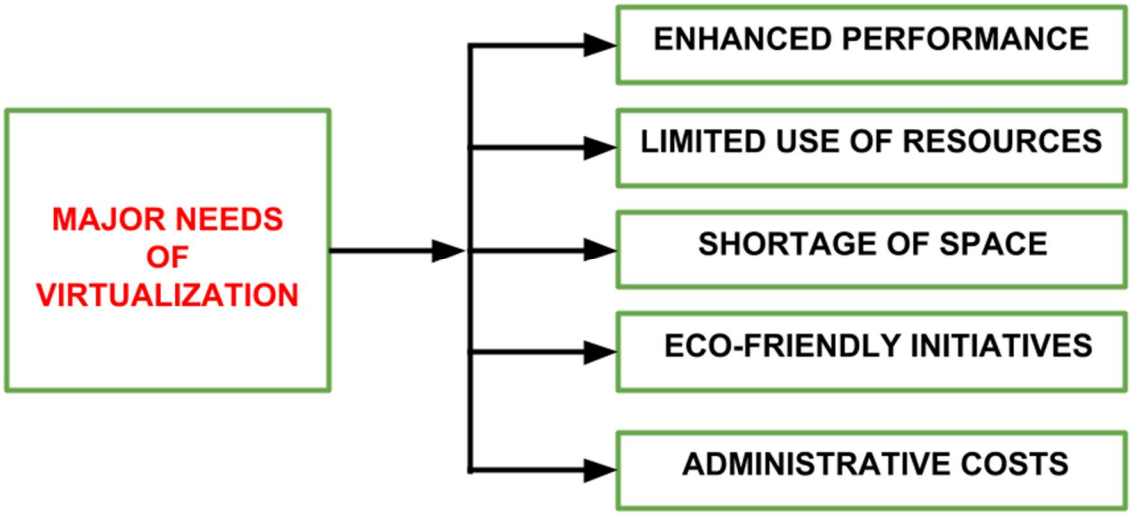

Fig. 3 Need of Virtualization

B. Traditional vs Virtual Service

Server as a whole includes storage, OS, Application & cloud computing technology. It receives request from cloud users & then responds to it.

C. Traditional Servers

Things could be easily run by system administrators as those servers were maintained by them. Whole unit was combined as a whole that included OS, Storage, hardware & application. But there are certain disadvantage in using them –

1) Replacement by new server if storage become full.
2) Physical infrastructure cannot be update.
3) Hardware maintenance was required which was expensive.
4) No duplication / Tedious duplication
5) Redundancy implementation is very difficult.

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D. Virtual Server

There Server usually encapsulates the server software away from the hardware. It consists of OS, Storage & application. By using / maintaining virtual server, we can reduce the stress on cloud provider by reducing their services. Virtual Servers would have great advantage over tradition once as they can maintain/ preserve resource and allocated them, High Hardware availability/ Flexibility , Ease in Deployment.

E. Virtualization Architecture

Virtualization Software allows multiple OS & multiple application to run on same server at same time. That is to say that space/ memory is virtually allocated to users in the server. In stead of using a real machine, virtual machines i.e. Computer software is used on which OS & application runs. The Physical resource server on which VMs run are called Host Virtual Machine are the guests.

F. Hypervisor

Hypervisor is a platform that allows VMs to operate on a single Hardware resource i.e. It basically provides system resource access to VMs and Partitioning capabilities. Hypervisor manage the core system/ Hardware processor memory & other resource to distributes requirement od OS. Example of Virtual Machine Monitor are VMWare, Xen, KVM.

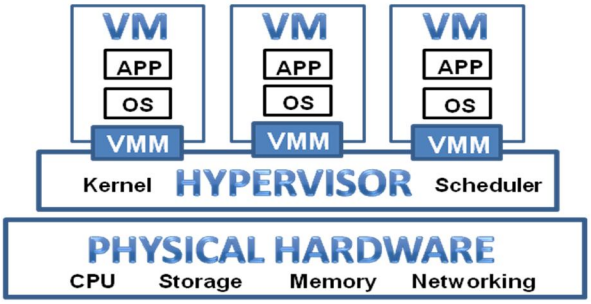

Fig. 4 Hypervisor

G. Types of VMM's / Hypervisor

1) *Bare metal or Native VMM:* These Virtualization software are directly installed on to the Hardware. They support Hardware virtualization & independent of OS. It houses many clients onto the same server to run in a virtual machine in as Isolated fashion & thus share a single machine or Host.

Some of the example include Xen server, KVM, Hyper VMware ESX Brands.

a) *Advantages:* Easy management, Flexibles & Scalable, Allow High Density Hardware.

b) *Disadvantage:* Accurate & Specific Hardware component requirement, Highly Expensive.

2) *Hosted Hypervisor:* This software machine is installed on an existing OS. It cannot run unless OS is already running. If failure of OS is detected it can affected all end users. They provide ease to run VM on PC for guest users as they co-ordinates calls for CPU, memory , disk, network & other resource though physical host's OS. These system software are installed between Hardware & VMs.

Some of example of Hypervisors are Microsoft Virtual PC, Sun Virtual Box, KVM(Kernel Based Virtual Machine) & X86 Hypervisors, etc.

a) *Advantage:* Easy access, Easy monitoring & backups, Better Hardware Compatibility than Type 1.

b) *Disadvantage:* Host OS needed, less performance & security, Low VM density.

H. Virtualization Technologies

1) *Full Virtualization:* This one kind virtualization provides VME that fully imitates the underlying hardware. User can run multiple guest OS simultaneously where one guest user/ virtual server is completely unaware of other virtual server that are running on physical machine. This technology requires a specific hardware combination & helps in a number of situation.

2) *Para Virtualization:* It communicates between Hypervisor & Guest OS only required resource are followed in Para virtualization. So resource can be easily accessed which enhances efficiency & performance. Here the guest OS is unaware of the other virtual machine which remove drawback of Full Virtualization.

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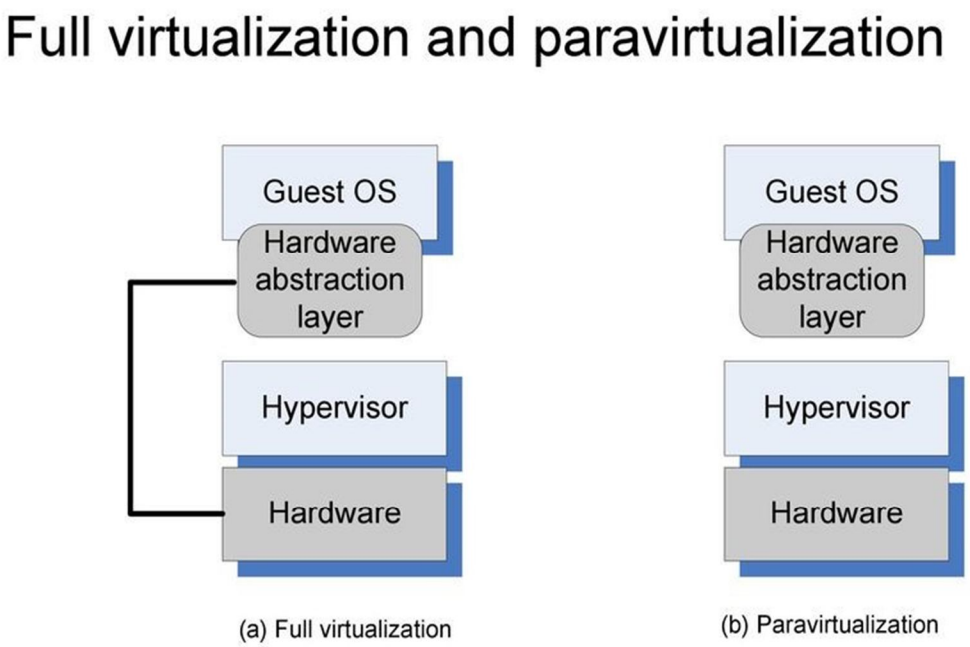

Fig. 5 Full virtualization and Para virtualization

I. OS level Virtualization

This techniques do not use Hypervisor for management of resource. OS is responsible for all functions of a fully virtualized Hypervisor. It creates Homogeneous environment.

J. Hardware Assisted / Accelerated Virtualization

This approach enable efficient virtualization using hardware capabilities. Basic server Hardware perform as Virtualization server. It can reduce maintenance overhead of Para virtualization & achieve better performance efficiency. However, it may involve many VM traps & thus high CPU overheads, limited efficiency & scalability of Server consolidation.

K. Types of Virtualization

1) *Storage:* Storage is virtualized to get large virtual storage and access by pay per go. It is further used for allocation resources to cloud clients.
2) *Software Virtualization:* Software by a group or large company can be used by multiple system at the same time with the help of a virtual layer (VMM).

L. Why is Virtualization ?

Along with its large range of advantages it can also provide isolation among user, virtualized dynamic resource Aggregation & sharing, cost Effective & Eco-friendly.

M. Security Threats & Challenges

Some of the major threats that pose risk to privacy & integrity of computing through virtualization are –

1) Mass Data Loss.
2) Infected applications
3) Data integrity
4) Attacks on Cloud layers – IaaS, PaaS. Or SaaS.
5) Attacks on VMMs – Insiders Virtualization specific attack outside/ External Virtualization specific attacks Co-residential attacks.

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N. Security Challenges

Even through virtualization has a huge potential to changes / enhance modern computing by its cost effective & low hardware flexibility, Scalability, Productivity & resource allocation , security experts have still concerned over certain loop hole & threats that could inhibit adoption of this full fledged technology for public.

1) Some of the major challenges include

a) *Loss of Control:* Computation & data are mobile & can be moved/migrated to different location so SU(service provider) can have direct control over this migrated data. Even the details of the service provided are unknown to the cloud provider.

b) *Mass Data Loss:* Disasters or anthropogenic activity hits can cause the loss/ destruction of data in the data centre or shutdown servers.

c) *Infected Application:* Virus attacks can pose threat to the whole system if one file gets infected.

d) *Data Integrity/ Privacy:* As users can access the data, exposure of sensitive information may lead to legal liability & loss of reputation.

2) Some Measure to counter these Security issues are

a) *Data Segregation:* User & guest information needs to be segregated in order to prevent privacy issues.

b) *Privileged user Access:* Sensitive data exposures should be limited and access should be regulated.

c) *Recovery:* Cloud provider should come up with data duplication & recovery mechanism to restore service services & data if loss occurs.

d) *Accountability:* Although they are different, it should be a mandatory approach.

Some of the Counter measure also include – Hardwiring VMM & VM , secure Programming , secure IAM(Identity & Access Management), Networking security & physical access restriction.

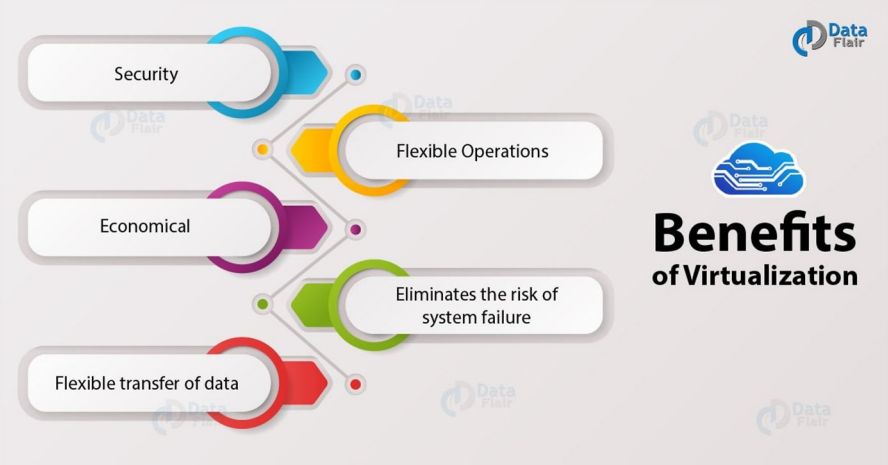

Fig. 6 Benefit of Virtualization

VI. METHODOLOGY

This analysis is based on study suggestion recorded on the Google form & detailed research to test the proposed Hypothesis. In our survey, outcome of total 37 participants were reviewed. This study survey was conducted with the help of some available resource.

A. Protocol

To collect data regarding Basics of virtualization

1) Public opinion (Google Form).

2) Study & Research were done.

Studies show that virtualization that came into begin in 1960's have gradually developed across time. Even through security issues are still underlying , cloud provides still prefer virtualization software over other options. To gather public opinion, surveys were conducted and various question were asked to find out if they utilize virtual cloud machine or a physical systems. Their knowledge regarding virtualization cloud computing along with security threats & suggestions regarding improvement they would like.

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B. Experiment

The outcome of survey analysis conducted by Chi Square Test with variable student and employees categories (yes/no) were x2calculated = 5.2727 and x2tabulated = 2.8714. Here x2calculated > x2tabulated therefore alternate hypothesis is accepted i.e. most of Students don't know about virtualization.

C. Observation

Survey outcome suggest only 16 out of 37 students do have knowledge about virtualization its uses, application & security threats. Therefore, the current hypothesis is rejected.

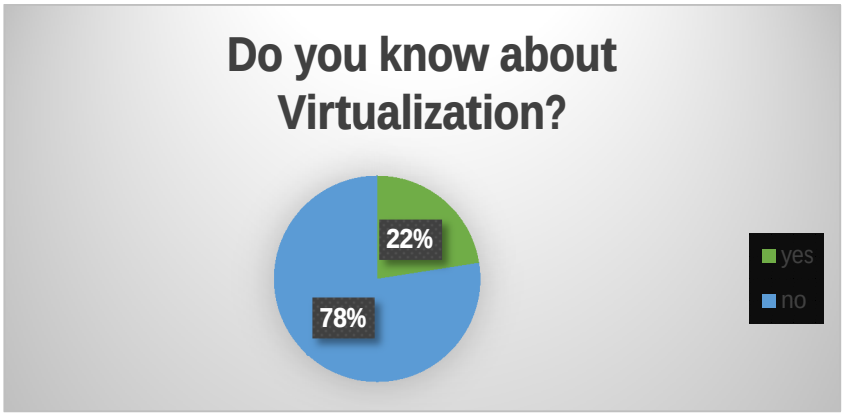

Fig. 7 Survey question responses

VII. RESULT

The observed result through survey & studies conclude that the proposed hypothesis (People do know about virtualization in cloud computing is rejected & the alternate people don't know about virtualization is accepted).

VIII. CONCLUSION

Hence, the feature paper describe the role of virtualization which separates OS from Hardware on which it is working. Virtualizing has overwhelming potential to change computing techniques. After VMs, were introduced , OS & application can be managed easily as one entity, can be provided to any system & are independent to Hardware. The paper reviews cloud computing service & also brief about Virtualization layer i.e. Hypervisor that acts as a connecting link between hardware & virtual machine.

In scenario where data storage is a sever problem virtualization has helped in managing data virtually. Over physical storage virtual servers can be installed over the use of Traditional one as virtual servers can exhibit minimum investment on resource & infrastructure & thus enhance maximum output.

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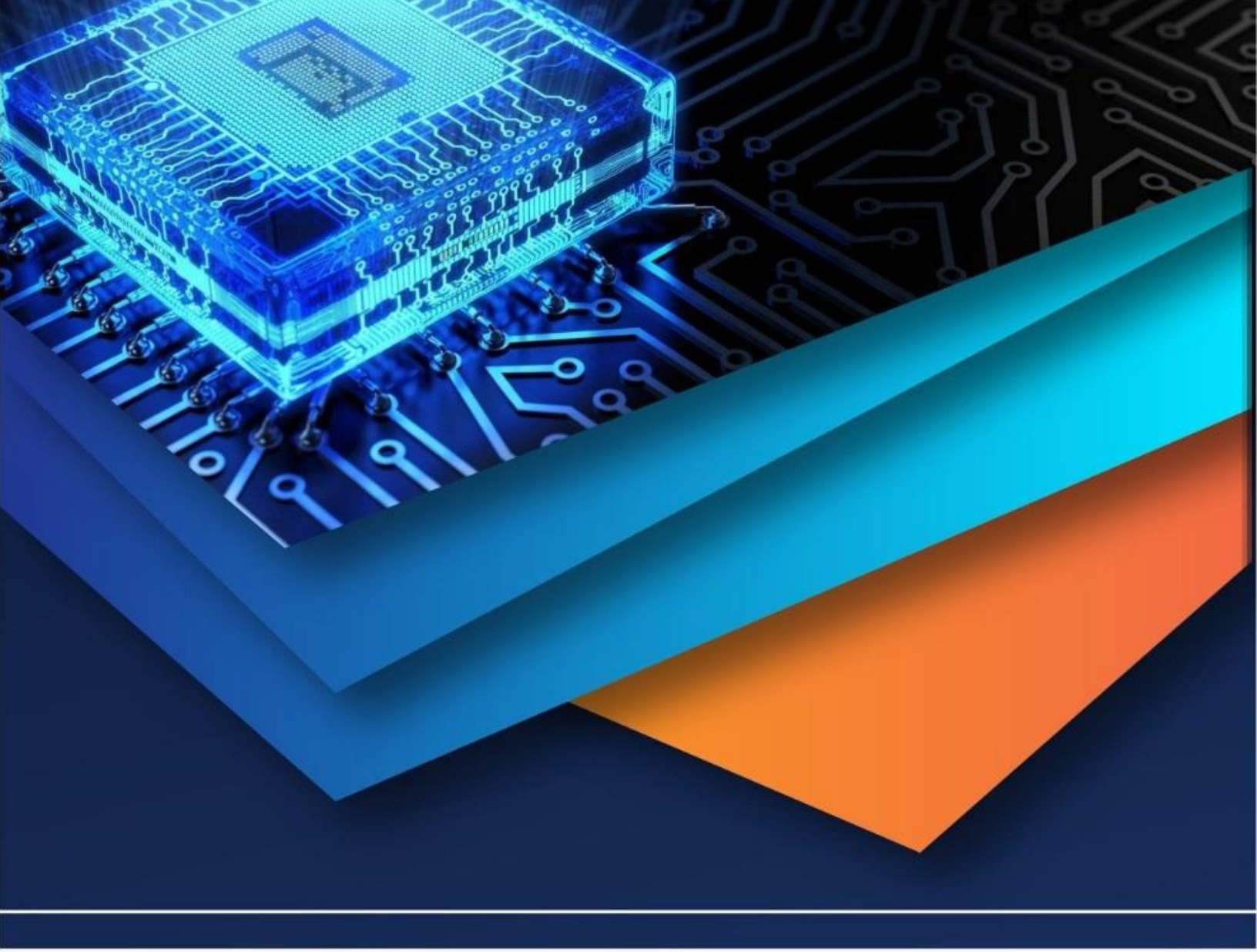

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