iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VII **Month of publication:** July 2017

DOI:

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VII, July 2017- Available at www.ijraset.com

System Capacity Improvement by on Request Channel Allocation in LTE Cellular Network

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Abstract*: The ever growing bandwidth demand for mobile applications, the long term evolution femto cells provide a promising solution. Femto cells operate at very low radio power levels less than cordless phones, Wi-Fi or many other house hold equipments. This substantially increases the battery life, both on stand by and talk time. The major 4G standards such as IEEE has adopted OFDMA as the main radio access technology for 4G standards such as WI-MAX and LTE. When in range of the femtocells at home, the mobile phone will automatically detect it and use it in preference to the outdoor cell sites. Cells are made and received in exactly the same way as before except that the signals are sent encrypted from the femtocells via broadband IP network to one of the mobile operators main switch centres. In this paper, efficient method to improve system capacity through interference management in the existing femto macro two networks has been proposed.
Keywords: Femtocells, Macrocells, On Request Channel Allocation Scheme, Wireless Cellular Network

I. INTRODUCTION

A cellular network or m land mobile network is a wireless network distributed over land areas called at cells, each served by at least one fixed location transreceiver, known as a cell site or base station. Fourth generation (4G) wireless systems are presently developed to meet the rapid increase in higher data rates. The major 4G standards are IEEE and 3GPP have adopted. OFDMA and it is a main radio access technology for 4G standards like Wi-Max (Worldwide Interoperability for microwave access) and LTE (Long Term Evolution). LTE is design to achieve high spectral efficiency using orthogonal frequency division access. OFDMA is a technique and which is used in long term evolution cellular systems to take multiple customers in a given band width. Orthogonal frequency division multiplexing is a modulation technique that divides channel into orthogonal multiple narrow bands. However, the main issue is indoor cell phone signal in long term evolution technology. In indoor environment has been generate more number of voice calls and data services. For so many days, the base station is working as macro base station, it has problem to maintaining powerful signals after passing through the walls so we have to provide satisfactory services for inside building users.

II. WIRELESS CELLULAR NETWORK

A cellular network is act like communication network, it is wireless network. This wireless network distributed over area of ground for some particular purpose land called cells, every sergeant had served by at least single fixed-location transceiver, known as a cell site or base station. We have to neglect interference and supply promised bandwidth within every cell, in mobile network every cell uses various set of frequencies from nearest cells.

Mobile networks provides a number of necessary characteristics

Long distance service region than a one earth based transmitter, since extra cell phone tower can be included indefinitely and restricted by the horizontal.

Use less power than with a single transmitter or satellite for hand held devices or smart phones.

Since the same frequency, can be used for multiple links as well as they are in different cells for more capacity than a single large transmitter.

A. Basic Concepts of Wireless Cellular Network

A geographical area to be supplied with radio service, which is divided into normal shaped cells, which can be square, circular or some other normal shapes, for our convenient hexagonal cells are convenient. The same frequencies are not reused in nearby cells as that would cause co-channel interference. Every cells assigned with multiple frequencies (f1-f6).

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They have corresponding radio base stations. The group of frequencies can be reused in different cells. For example Taxi Company, if each radio had tune different frequencies by manually operated channel selector. The drivers change channel to channel when they moved around. The approximated area cover by which frequency. So transmitter did not receive a signal, they found one that worked when they would try to other channels. So base station is operator invited when taxi drivers would .speak only one at a time.

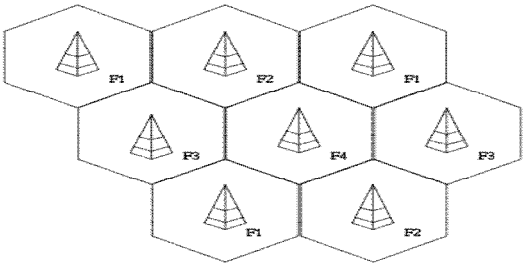


Figure1.Example for a cellular network

III. FEMTOCELLS

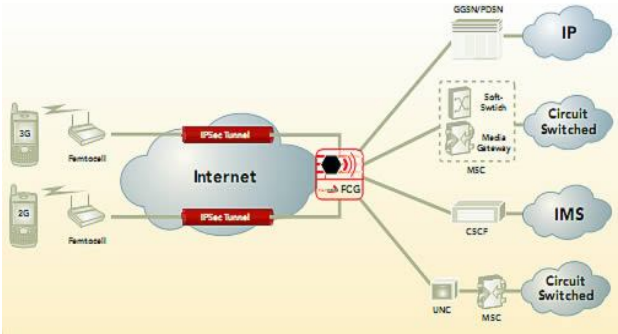
Femtocell is a low power cellular base station, used for home or small company. It is useful and piece of technology. Where the signal can be weak so this femto cells are covered every areas of mobile phone network. Sometime the phone signal is weak while mobile phone is inside the home. But some time we are in outside of the building this problem won't happen. When the coverage is poor all this issues are happen.

The femto cells can be used in place to extend network coverage, while satellite not coverage by the local area so we have to use femto cells. Then the femtocells base station can be setup in high speed internet in any places, then users can be easily take the help from this. The wireless network coverage can be included both mobile phones and smart phones, and operated in bands of licensed frequency. 3G phones are not properly operated in buildings, so it can be blocked or hanged by certain issues. Good signal is find in outside only then mobile phones are operated very fastly in case of calls and data.

A. Existing Network Problems

The rooftops or steel towers which contained traditional cell sites, they require thousands of pounds of equipment. These are require costliest broadband, the connections cellular telephone switch and cell site, also maintain painful site releases, costly backup power and they maintain 24/7/365.The sites are acting as high cost. They need to Distributed Antenna Systems (DAS), if the coverage shrinks automatically indoor coverage suffers from it. When customers are in airport, large office building or convention center that time DAS applicable, because it expensive for small business.

Femtocells to individual customers while cellular operators offers these cells. Femtocell operator cost is hundred dollars and it contains the size of a Wi-Fi. The customers provided the broadband internet connection, so customers taken many help from femtocells while it will connect to broadband and their no cost. Very low transmitter power, femtocells are designed to cover up to hundred square feet. Within femto cells range macro cells are operated for this reason chosen CSG.



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B. Femtocell Specification

Femtocell specifications for wireless standards organization and such an air link protocol vary from different standards.

1) Network management system: To make software updates from the system, it allows network operator and run diagnostics using standard management protocol, TR.069.
2) Self-organizing base station: Macro cell base stations are requiring complicated base radio resource functions, femto cells are optimize and configure themselves only.
3) Femtocell gateway: The gateway which enables encrypted IP connections and provides security functions. Each femtocells authenticates and interfaces with mobile telephone switch.

C. Advantages and Disadvantages

Benefits**:** The increased customer satisfaction at low cast, so it will benefits to network. The femtocell is more reliable for indoor service, and also more benefits from femto cell users. The expensive wireless infrastructure to low cost broadband connection while operator also shields traffic.

1) Issues: The operator was potential for harmful interference to the macro cell network, while femtocells were introduced.

IV. SYSTEM MODEL

In indoor and outdoor environments with macro cells are distributed by many numbers, also defined mobile stations and femto cells. A cell consists of seven hexagonal macro cells each cells divided by centre zone and edge zone. Edge zone is divides into three sectors.

Every sector has 10 meter bandwidth and 500 meter radius. The femtocell base stations are installed where macro cells located in residential area. The random location is within the macro cells range. Femtocells covered up to 10 meters, each femto cell base station is considered from femto cells user in an indoor environment. The number of apartments is find in three floor building is contains macro cells. We find different way for apartments through many roads and streets. In closer subscriber group (CSG) femto cells can be operated. Within femto cells range macro cells are operated for this reason chosen CSG.

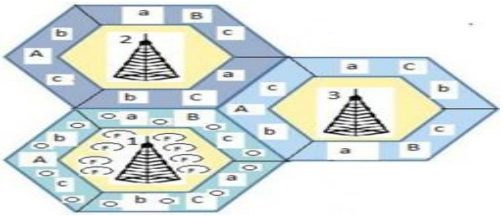

Figure2.Femtocells deployment in Macrocells

A. System parameters

Parameters	Values	
	Macro	Femto
Number of cells	7	40
Radius	600m	20m
BS transmitter Power	20W/17W	20mW
Topology	3 sectored 7 hexagonal cell	Density of 5 per Macrocell
Number of UE	5 per Macro	1 per Femto
Bandwidth	10 MHz	
Number of Total PRBs	24 PRBs (PDSCH),1 PRB (PDCCH)	
Subcarrier Bandwidth	375 kHz	
Subcarrier spacing	15 kHz	
Carrier frequency	2 GHz	
Channel Model	3GPP Typical urban	

Table1.System Parameters

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B. Problem Formulation

1) SINR: For Femtocell user FUE F received SINR is given as follows:

SINRF, K = PF,k',PZ,F,m,k' XF,K ÷ N0+∑F'PF',k'PL,F',m,k',XF',k (1)

The PF,k, PF',k and PM,m,k are denoting as Serving Femtocell Base Station (SFBS) while transmit powers, with respectively PRB k is Neighbour Femtocell Base Station(NFBS) and Macrocell Base Station(MBS). PZ,F,m,k denoted as the path loss between FUE F and helping BSI.P'I,F',m,k it is also denoted as path loss between FUF F and its adjacent Femtocell BS, which is denoted as interfering signal on F. One PRB doesn't share at a time more than one user while XF,k=1, XF',k=0 and XM,m",k=0. If there is no PRB covered by the F user, is denoted as XM,m,k=0. To represent the indoor, outdoor, outdoor to indoor and indoor to outdoor the Path Loss Models are used.

C. Path Loss

Path loss models are used to represent indoor, outdoor, and indoor-to-outdoor (and vice versa) channel environments. These are best suited for a dense urban Femtocell deployment. Path loss LS is determined by the distance between the transmitter and receiver for each subcarrier. Three models for the channel path loss are described here.

1) *UE to Femto-BS:* The path loss LS for interfering and Non-interfering links between a Femto UE or a Macro UE and a Femto-BS is expressed as

$$LS = 127 + 30[Og10\ (d/1000) \qquad (2)$$

Where path loss LS is in dB, d (meters) is the distance between transmitter and receiver.

2) *Outdoor UE to Macro-BS*: Path loss for non-interfering link between outdoor M-UE and serving M-BS as well as interfering links between outdoor Macro-UE and neighbouring Macro BS is calculated as

$$LS = 15.3+ 37.60[Og10\ (d) \qquad (3)$$

3) *Indoor UE to M-BS:* This path loss model takes into account the wall penetration loss (L W) as the signal travels from indoor to outdoor and vice versa between an indoor located UE (Macro-UElFemto-UE) and Macro BS.

This is calculated as

$$LS = 15.3+ 37.60 \log10\ (d) + Lw \qquad (4)$$

D. Throughput Calculation

Throughput is calculated as follows using Shannon capacity formula.

$$C\ user= \sum n=1Bo\cdot 1092\ (1 + 51\ N\ R) \qquad (5)$$

The throughput of base station is the sum of its serving UEs and Bois the bandwidth of one PRB.

V. ON REQUEST CHANNEL ALLOCATION SCHEME

The cells always using a same frequencies, maintained certain distance between the cells to minimize interference. However, cell reuse pattern is not disturbing from reduced distance. The same frequencies can be utilized in more cells as well as the sizes of cells are reduced, the system accommodated from the more subscribers.

For example, a radius of a cell is 8 mi and divided into four cells, with each new cell having a 2 mi radius. Cell splitting is best way to increase system capacity, it will reach some practical limitations. Cell sites become more difficult in suitable locations. Rapidly increases processing load on the switch rapidly because handoffs working as more frequently.

The idea of this scheme is to reduce downlink interference from femto cell base station to MUEs (macro cell user equipment) and FUEs (Femtocell user equipment) through on request channel allocation. Here we considered SFR (Soft Frequency Reuse). In SFR cell centre users are not are not affected to the other cell centre users. Simultaneously using the same PBB is considered here so the mutual interference between two users like serving cell-edge users and cell-edge users from different cells.

A. Sectoring

Sectoring consists of cell site into non-overlapping slices is directly view of an omni directional (360 degree), is called as sectors. When they are close to each other, if they are separate cells then only they provide same coverage. It is inexpensive capacity and

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one of the easy increasing solution. In normal way, while the single omni directional antennas replacing at base station with several omni directional antennas, then each radiating within specified sector.

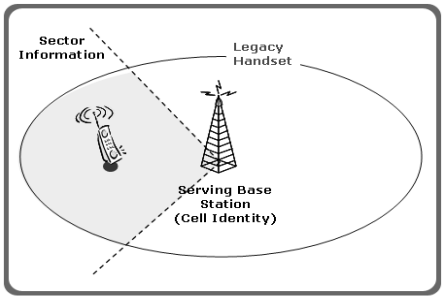

Figure3.Cell sectoring through Omni directional antenna

B. Advantages

1) It enables to reduce the cluster size and provides an additional freedom in assigning channels.

2) Improves S/I ratio.

3) It reduces interference which increases capacity.

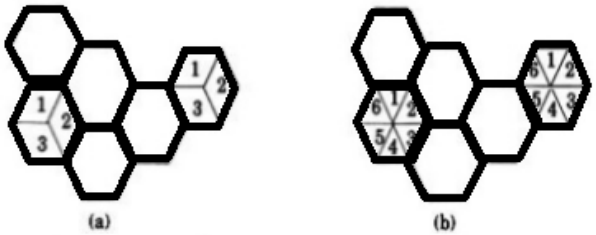

Figure4.Cell sectoring (a) 120 sectoring (b) 60 sectoring

C. Channel Allocation

The coverage of the macro cell is divided into edge zone and centre zone. Edge zone has covered by three sectors each sub-area marked as A, B, C and each located by 120 degree. Each sub-area has virtual sub-sectors denoted as a, b, c and each located by 60 degree. Which are allocated as the same frequency sub-band and power of A, B, C respectively. Different frequency sub-band allocated in each macro cell sub-area.

D. Interference Cancellation

Figure shows that virtual sub sectors c and b are present in the sector A. Macrocell users located in this sector these taking help from sector A which has a frequency sub-bands. In other words frequency sub-bands allocated for B and c sectors these are used by edge users of femto cell or macro cell, which are located in virtual sub-sectors b and c respectively. So there is no interferences in both users, like macro cell and femto cell hence they are using different frequency sub bands. Sector B has 2 virtual sub-sectors like a and c, Sector C has 2 virtual sub-sectors like a. In above figure mentioned femtocells in different sectors.

VI. SECURITY REQUIREMENTS

A. Portability

The application is user-friendly so it is very easy for user to understand and responding at the same time.

B. Reliability

To deliver us correct simulation and the functionalities then the system has work high probability and they are available in the applications.

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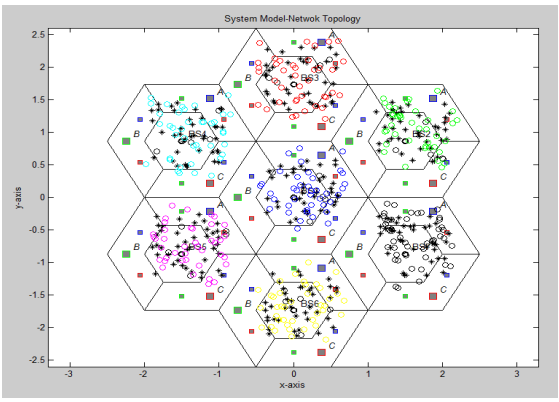
C. Response Time

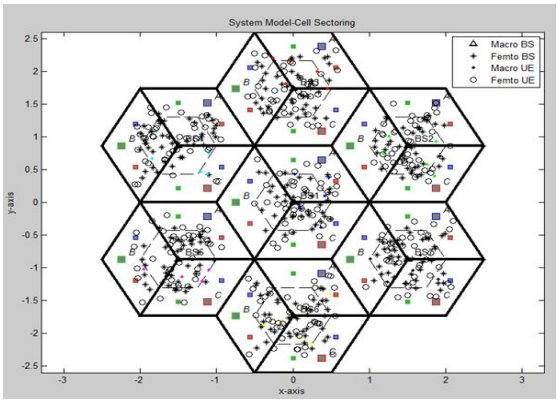
The system is to complete a simulation depends on the power allocated to the nodes while how much time taken by the system.

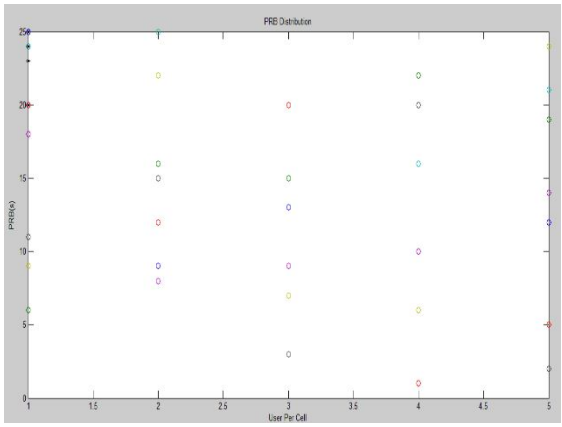
D. Scalability

In present application to improve the quality of the product so it can be done in the system, then it can be extended to integrate the modifications.

RESULTS







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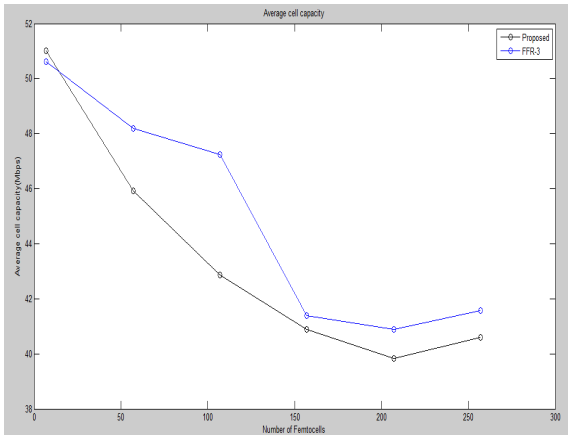

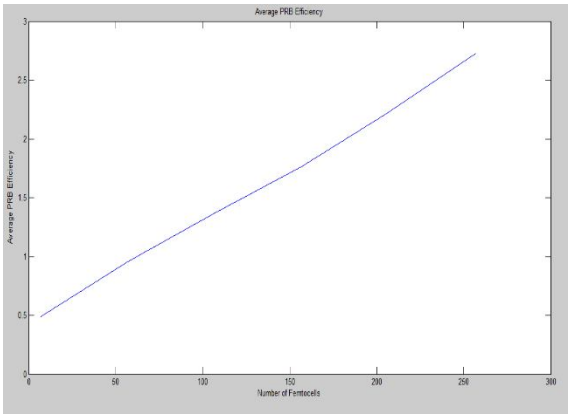

VII. CONCLUSIONS

Femtocell technology is advanced technology, it will provide many advantages to the mobile users. So Femto cells are looked like a promising option for upcoming generation. There is an interference problem because of more number of proper frequency band allocation method. Wireless communication networks are OFDMA based LTE networks. Femto cells and Macro cells allows from channel allocation knowledge it is based on reducing of interference technique, these cells are having edge users to on request basis of access PRBs and also to satisfy the higher rates. The main advantage of this project to save more spectrum it is based on request based PRB allocation. The simulation results are based on “On Request” method, it can increases the throughput as well as reduce the interferences.

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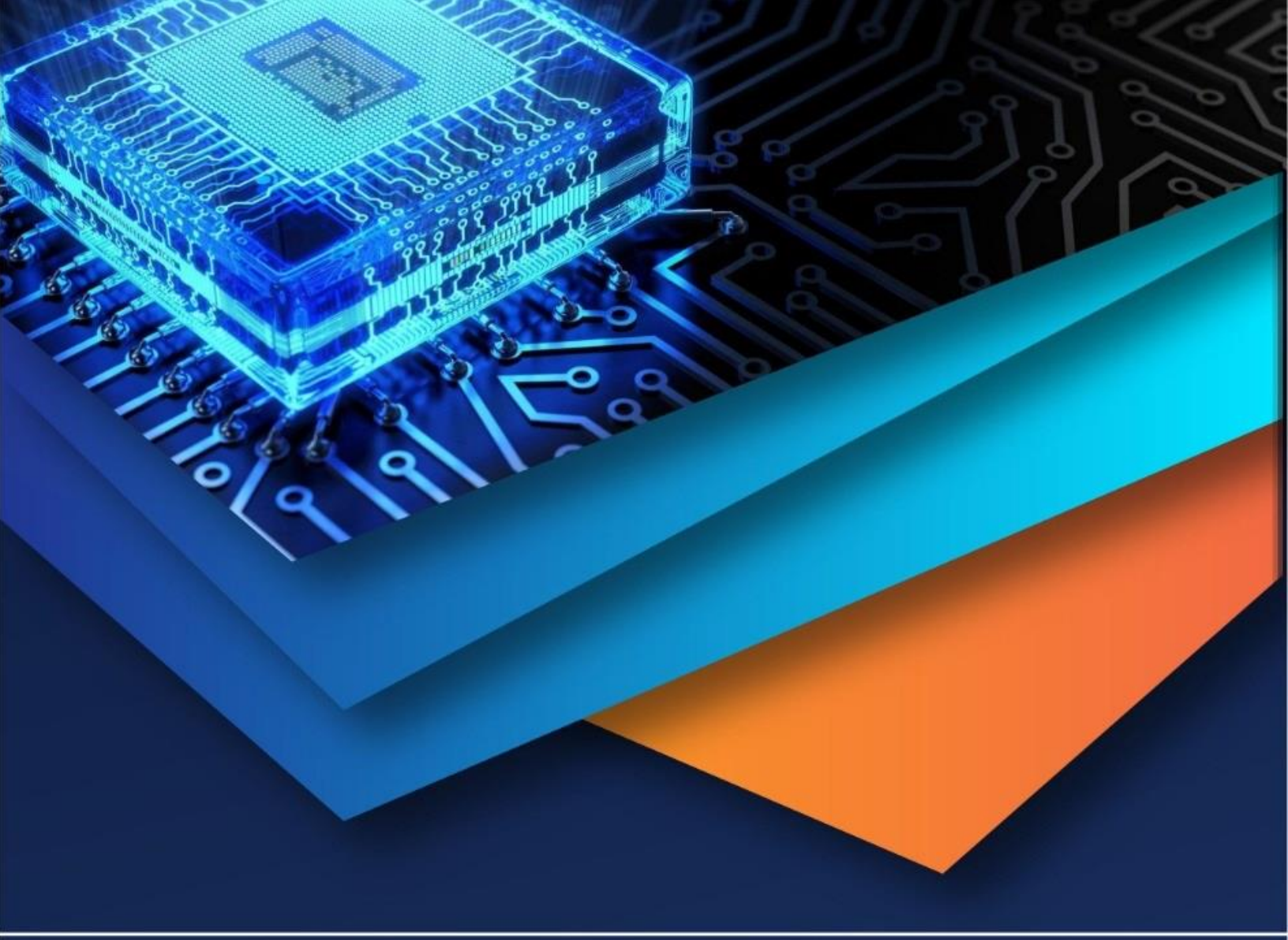

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