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Design and Analysis of Fragmentation Threshold and Buffer Size of Wireless LAN using OPNET Modeler

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Abstract: In this paper, we analyze the fragmentation Threshold and Buffer Size performance of IEEE 802.11g Wireless Local Area Network (WLAN) with one access point. The IEEE 802.11g is a wireless protocol standard. In this paper, a wireless network was established which has one access point. OPNET IT Guru Simulator (Academic edition) was used to simulate the entire network. Here Performance Optimization has been shown via a series of simulation tests with different parameters such as Data rate, Fragmentation threshold, Buffer size and the physical characteristics. In this paper we considered the effects of varying the fragmentation Threshold were observed on the Delay, Media Access Delay, Queue Size and throughput performance metric. Several simulation graphs were obtained and used to analyze of wireless network.
Keywords: Access Point (AP), Medium Access Control (MAC), OPNET, Wireless local area networks (WLANs), Data-rate, buffer size, fragmentation threshold, and throughput.

I. INTRODUCTION

The IEEE 802.11 standard [1] defines the protocol and compatible interconnections of data communication equipment via the “air” (radio or infrared) in a local area network (LAN). It encompasses the physical (PHY) and the media access control (MAC) layers of the ISO seven-layer network model. As technological advances in IEEE 802.11g wireless networking presents us with larger bandwidths, faster speeds and better quality of service (QoS), WLANs are becoming more widely deployed and intensely used. A WLAN is comprised of one or more access points (APs) and a number of mobile wireless clients. An AP is a wireless node connected to a high-speed wireless network. The job of the AP is to link the transmissions between wireless networks. An AP operates on Open Systems Interconnection (OSI) Layer 2 (Data Link layer), but some models may also operate on OSI Layer 3 (Network layer) by acting as a router. However, the WLAN performance is a key factor in spreading and usage of such technologies.

So In this paper deals with the optimization techniques based on the OPNET Modeler. OPNET MODELER is used to design and study wireless networks, devices, protocols and applications. It provides a graphical editor interface to build models for various network entities from physical layer modulator to application processes [2]. Workflow of OPNET Modeler is given in figure1.

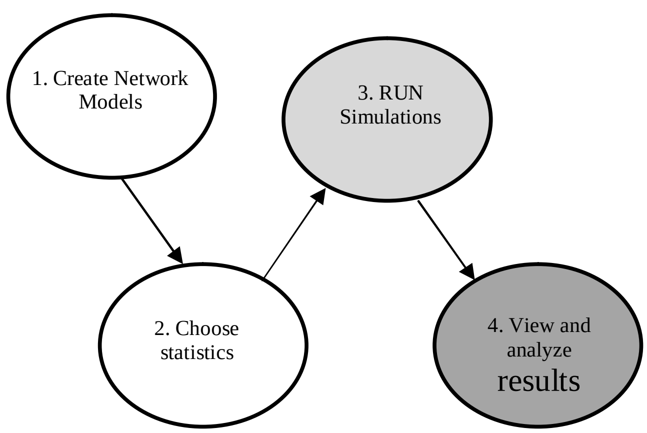

Fig.1 Workflow Model[2]

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II. NETWORK DESIGN

Project Editor is used to develop network models. Network models are made up of subnets and node models. This editor also includes basic simulation and analysis capabilities. The Project Editor is the main staging area for creating a network simulation. From this editor, we can build a network model using models from the standard library, choose statistics about the network, run a simulation and view the results.

Node Editor is used to develop node models. Node models are the objects in a network model. They are made up of modules with process models.

Process Editor is used to develop process models. Process models control module behavior and may reference parameter models.

ICI Editor is used to Create, edit, and view interface control information (ICI) formats. ICIs are used to communicate control information between processes.

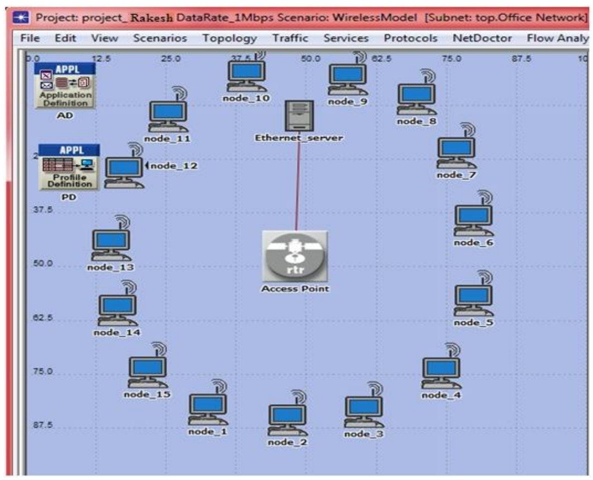

Fig.2 Network Model of 15 nodes with one access point

A. Performance Parameters

There are different kinds of parameters for the performance evaluation of the different attributes. These have different behaviours on the overall network performance. We have evaluated four parameters for the comparison of our study on the overall network performance. These parameters are delay; media access delay, Queue size and throughput for consideration QoS of WLAN.

1) *Delay:* Hence all the delays in the network are called packet end-to-end delay, like buffer queues and transmission time. Sometimes this delay can be called as latency; it has the same meaning as delay. The packet end-to-end delay is the time of generation of a packet by the source up to the destination reception [5]. So this is the time that a packet takes to go across the network.
2) *Delay Media Access:* We measure media access delay as the time from when the data reaches the MAC layer until it is successfully transmitted out on the wireless medium.
3) *Queue size:* Queue size and waiting time can be looked at, or items within queues can be studied and manipulated according to factors such as priority, size, or time of arrival. Networks of queues are systems which contain an arbitrary, but finite number ‘m’ of queues. Customers, sometimes of different classes, travel through the network and are served at the nodes. The state of a network can be described by a vector (k1,k2,….,ki), where ki is the number of customers at queue i.
4) *Throughput:* In a wireless network, system throughput is defined as the fraction of time that a channel is used to successfully transmit payload bits [7]. Throughput can be obtained by analyzing the possible events that may happen on a shared medium in a randomly chosen slot time.

B. Network Model

The First network model consists of four scenarios for 15 nodes configured for the 4 referred Fermentation Threshold as:

1) *Scenario 1:* FTS 15 (256 bytes) Scenario
2) *Scenario 2:* FTS 15 (512 bytes) Scenario
3) *Scenario 3:* FTS 15 (1024 bytes) Scenario
4) *Scenario 4:* FTS 15 (None) Scenario

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The Second network model consists of four scenarios for 15 nodes configured for the 4 referred Buffer Size as:

5) *Scenario 5:* BUFFER SIZE 15 (64000 bits) Scenario
6) *Scenario 6:* BUFFER SIZE 15 (128000 bits) Scenario
7) *Scenario 7:* BUFFER SIZE 15 (256000 bits) Scenario
8) *Scenario 8:* BUFFER SIZE 15 (1024000 bits) Scenario

All these scenarios are contained in the network model, each configured for different attributes.

III. SIMULATION RESULT

A network which has one access point and 15 nodes was set up as shown below. Simulations were carried out using OPNET IT Guru simulator (Academic edition). The effects of varying fragmentation threshold and buffer size on the delay, media access delay, queue size and throughput as a performance metric were analyzed.

A. *Fragmentation Thresholds*

The maximum frame size wireless device can transmit without fragmenting the frame is called fragmentation threshold. A collision happens when two devices that use the same medium transmit packets at exactly the same time. The two packets can corrupt each other, and the result is a group of unreadable pieces of data. If a packet results in a collision, the packet is discarded and it must be transmitted again

TABLE I
FRAGMENTATION THRESHOLD USED FOR DIFFERENT SCENARIOS

Attributes(Parameters)	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Data Rates (Mbps)	54	54	54	54
Transmit Power (mW)	100	100	100	100
Fragmentation Threshold (bytes)	256	512	1024	N
Buffer Size(bits)	1024000	1024000	1024000	1024000

Table I shows the four scenarios for the simulation study. The first one is with a fragmentation of 256 bytes incoming packets. The second one is with a fragmentation of 512 bytes, and the third one is with a fragmentation of 1024 bytes and the forth one is with no fragmentation of incoming packets.

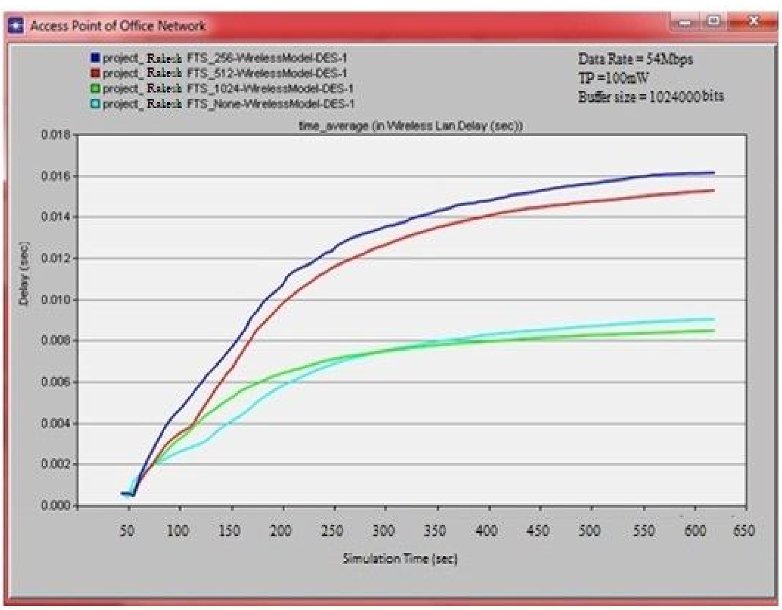

Fig. 3 Delay results for different fragmentation threshold

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Fig. 4 Media Access Delay results for different fragmentation threshold

Fig. 5 Queue Size results for different fragmentation threshold

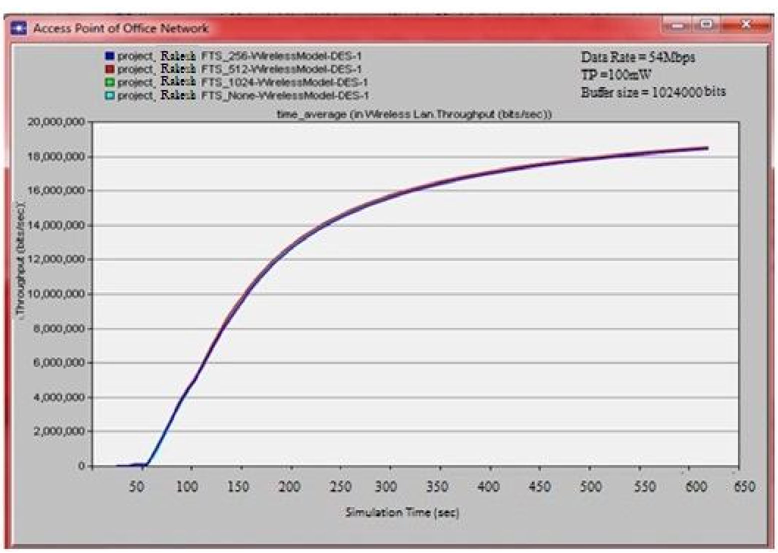

Fig. 6 Throughput results for different fragmentation threshold

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From the above fig. 3 and fig. 4, the advantages of increasing the fragmentation threshold are the following: media access delay in WLAN diminishes, global packet end-to-end delay diminishes, and global packet delay variation diminishes.
Based on the simulation of the four scenarios for the fragmentation threshold, the graph in fig. 5 shows that, when increasing fragmentation threshold from 256 bytes to None, the queue size is decreased.

Table III
COMPARISON RESULTS OF DIFFERENT PERFORMANCE METRIC USED FOR DIFFERENT FRAGMENTATION THRESHOLD

Fragmentation Threshold(bytes)	Delay(ms)	Media Access Delay(ms)	Queue Size(packets)	Throughput(bits/s)
256	16	24	88	1,85,00,000
512	15	17	80	1,85,00,000
1024	9	11	77	1,85,00,000
N	9	8	65	1,85,00,000

B. Buffer Size

This parameter specifies the maximum length of the higher layer data arrival buffer. If the buffer limit is reached, data received from the higher layer are discarded until some packets are removed from the buffer so as to have some free spaces to store new packets. The table III shows the buffer sizes used.

TABLE IIIII
BUFFER SIZE USED FOR DIFFERENT SCENARIOS

Attributes(Parameters)	Scenario 5	Scenario 6	Scenario 7	Scenario 8
Data Rates (Mbps)	54	54	54	54
Transmit Power (mW)	100	100	100	100
Fragmentation Threshold (bytes)	N	N	N	N
Buffer Size (bits)	64000	128000	256000	1024000

Fig.7 Delay results for different buffer size

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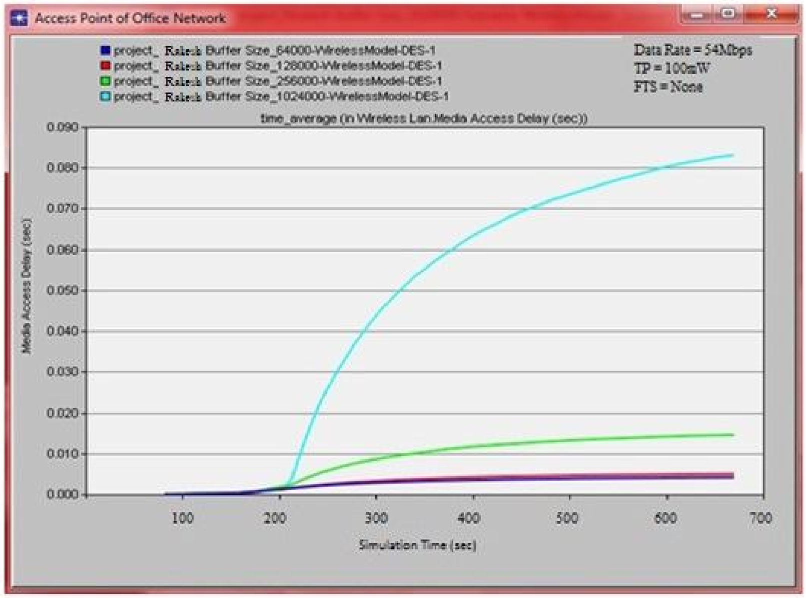

Fig.8 Media Access Delay results for different buffer size

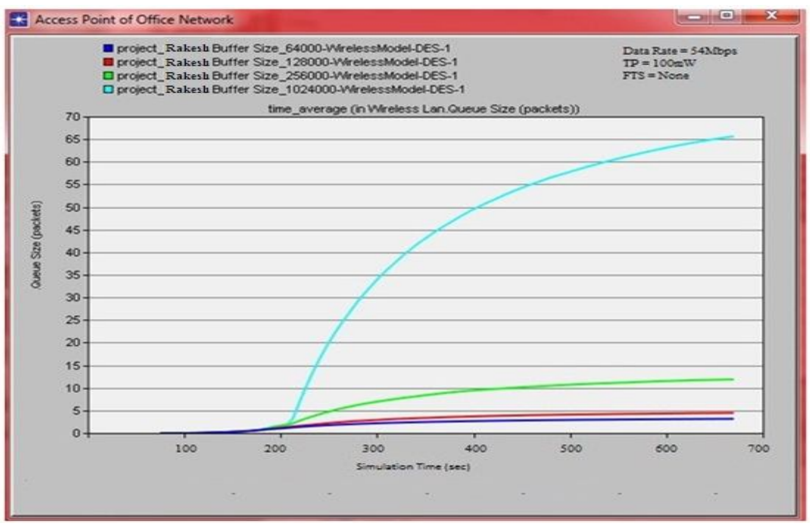

Fig.9 Queue size results for different buffer size

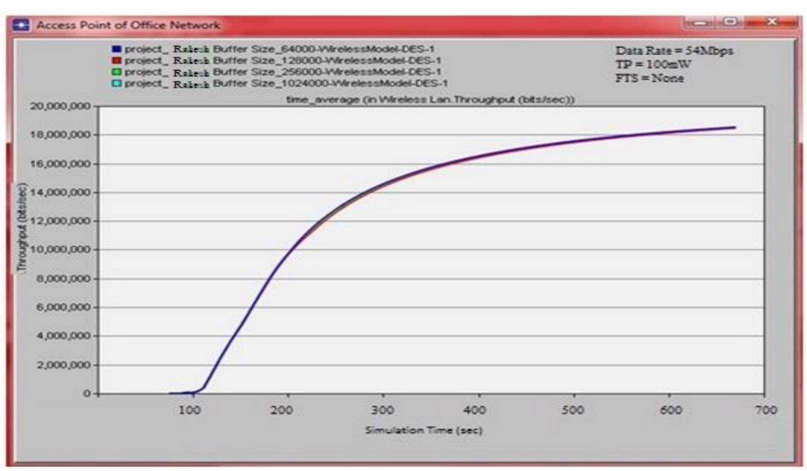

Fig. 10 Throughput results for different buffer size

When the size of the buffer is increased as shown graph in fig. 7, the delay decreased. For the small size of buffer, the delay reached to maximum. Hence the buffer size should be maximum to achieve minimum delay in wireless network. The graph in fig. 8 shows that, initially when the size of buffer was small the media access delay is to be achieved minimum, when the size of buffer increased continuously there will be no space in it to store new packets. Hence there queuing will generate which would increase media access delay. The simulation result as shown in fig. 9 shows that, initially when the buffer size was small there was free space to store the new packets in the buffer. When the buffer size is increased continuously there is no space to store new packets. Hence there queuing will generate, thus the queue size is increased with increase in buffer size. As per the simulation of the four scenarios for the buffer size as shown in fig. 10, it has been found that when the buffer size in wireless network is increased, the throughput increases.

Tbale IVv

COMPARISON RESULTS OF DIFFERENT PERFORMANCE METRIC USED FOR DIFFERENT BUFFER SIZE

Buffer size(bits)	Delay(ms)	Media access delay(ms)	Queue size(packets)	Throughput(bits/s)
64000	6	4	3.1	1,85,00,000
128000	7	5	4.5	1,85,00,000
256000	8	14	12	1,85,00,000
1024000	9	83	65	1,85,00,000

When the size of buffer increased continuously as shown in table 5.8, the delay, media access delay, queue size and the throughput increases, If the buffer limit is reached, the throughput remains constant because data received from the higher layer are discarded until some packets are removed from the buffer so as to have some free space to store new packets.

IV. CONCLUSIONS

This Paper focuses on the designing of the wireless network. It was found that the main challenges of such type of network are delay, media access delay, queue size and throughput. Having completed this simulation, it is seen that when a network parameters such as data rate, transmit power, fragmentation threshold and buffer size is tuned to different scenarios, the delay media access delay, queue size and throughput performance metric is usually affected.

When the fragmentation threshold in a wireless network is increased and other parameters such as data rate, transmit power, and buffer size are constant, the delay, media access delay and queue size decreases and throughput remains constant because of the number of packets also remain constant and only a packet size is fragmented into small packets.

Initially when the size of buffer was very small the delay, media access delay is to be achieved minimum, and the throughput is to be reduced to zero for small buffer size, meaning that packets are dropped or discarded because the buffer has no space to accommodate more packets. When the size of buffer increased continuously, hence there queuing will generate resulting in the delay, media access delay, queue size and the throughput increases. If the buffer limit is reached, the throughput remains constant because data received from the higher layer are discarded until some packets are removed from the buffer so as to have some free spaces to store new packets.

V. ACKNOWLEDGMENT

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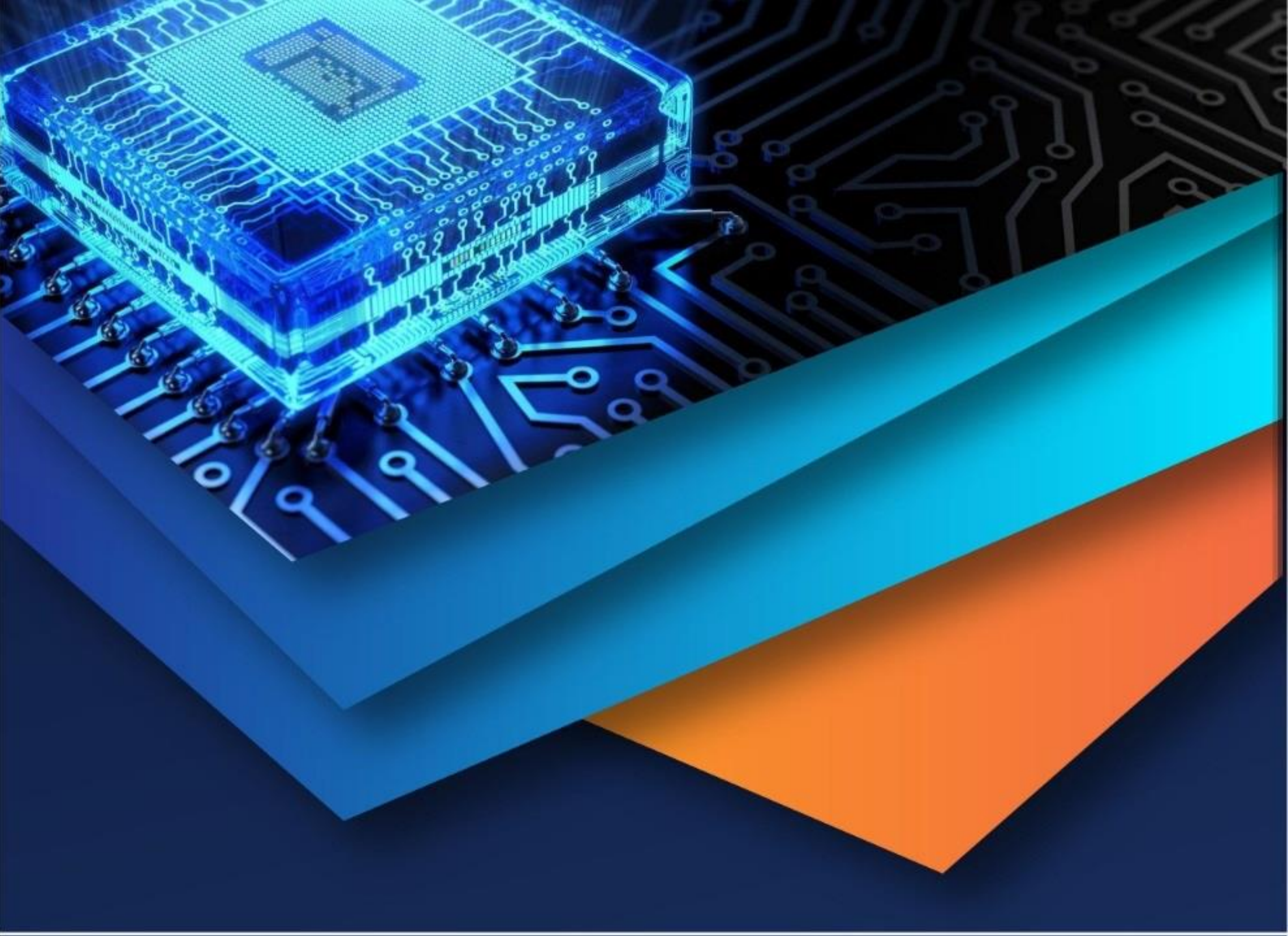

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