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Balancing the Load on Cluster Head in MANET

Mr. Sandeep Mukherjee[1], Mr. Rakesh Kumar Singh[2]
[1]*Asst Prof., CSED, SIET, Jhalwa, Allahabad*
[1]*M.tech. Scholar, KNIT, Sultanpur.*
[2]*Professor, CSED, KNIT, Sultanpur*

Abstract: ***Wireless Communication is one of the most efficient and effective routing technique. If the packet loss has to be minimum then wireless routing technique proves to be efficient and effective method. MANET is automatically self configured and multi hop configured routing technique. When the talk on network simulating tool to configure the network is raised, NS2 hits the top position but as the comparison has to be done so to do that present scenario of the AODV with enhanced AODV protocol MATLAB 2014A is best, which provides support for the mathematical operation among all the others. As far as the reactive routing protocol comes in ADHOC network hits the top list for the discussion of MANET, and when the network breakage and link error comes it's all due to mobile node used in the transmission. In today's scenario demand on efficient network is difficult task for any network topology or method, its mainly due to dynamic topology used in Adhoc network. Again due to heavy load on the node due to bandwidth information it makes it more difficult to anyone to achieve performance in network.***

Keywords: Ad hoc Network, Routing Protocol, Load Balancing, Clustering, Packet delivery ratio, Load on cluster head.

I. INTRODUCTION

In ADHOC Networking technique when the wireless network is take into account with the dynamic collection of independent nodes moving independently and undergoing communication between them using electromagnetic waves in the wireless network MANET comes into the business. The nodes which are in sensor range of one other can directly communicate while the nodes which are far away need to talk through intermediate nodes. This network can work independently at any place with the help of infrastructure which are distributed evenly. This makes it flexible, robust and reliable. The dynamic change in MANET topology makes routing as a challenging task, as the existing path is rendered inefficient and infeasible. The major issues for mobile ad hoc networks are medium access control (MAC), routing, security and maintaining the transmission network alive for the maximum number of transmission rounds. This paper mainly focuses on the routing problem in a mobile ad hoc network without considering the other issues such are security. Routing through MANET means to transfer packets of data without having a static infrastructure, and making all the transmission independently.

The main objective of the paper is to enhance the network performance of AODV with balanced nodes in route transmission, which is responsible for the frequent breakage of the link between the nodes of the network. The performance analysis and simulation are carried out to evaluate network performance using MATLAB 2014A, based on the quantitative metrics packet delivery ratio and average end to end delay. The behaviour and mobility of the AODV protocol is detected using the simulation results. AODV

Mobility is analysed to show its ability to adapt in real world networks. This paper proposes new enhanced AODV which focuses mainly on the load on the cluster head following the same route for the transmission.

The main characteristics of the network are as under:

1) Communication through wireless Network.
2) Non-centralized control and Infrastructure.
3) Dynamic Node network topology.
4) Randomly routing update.
5) Single node behaves as host and router.
6) Mutual Communication between the nodes
7) Main applications of MANETs are:

Disaster controlling operations such as
8) Defence
9) Urgent Business Communications
10) Site operation and monitoring.

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MATLAB in today's era is one of the most demanding tool for the researchers, and professors. The process of creating a model using its behavior is known as Simulation. To perform the Adhoc Network Simulations various simulating tools are available mainly are OPNET , NetSim, NS-2, etc. Since the project focuses on the load balancing of the nodes and calculation are needed .So MATLAB outperforms among all the other tools. MANET is usually done in conventional routing protocols which are DSDV, DSR, AODV and AOMDV using NS2 and it's available as free open source programs. In this research paper AODV routing protocol is considered and all the focus in done on the same and termed as Enhanced AODV.

Whole paper is divided into some sections such as, section II focuses on the overview of Routing Protocol of MANET and section III describes the Reactive Routing Protocol AODV, section IV explains the enhanced load balanced E-AODV, section V describe MATLAB implementation of E-AODV, section VI discusses about simulation results and analysis and finally section VII discusses about conclusion derived from the implemented results.

II. ROUTING PROTOCOLS FOR MANET

Routing protocols in ad hoc networks vary depending on the type of the network. Usually main classification on ad hoc network is done on the basis of routing protocols, which are

i). proactive, ii) reactive routing protocols and iii) hybrid protocols.

Additionally, other way of categorization of the protocols are power aware protocol and protocols can also be classified according to the utilization of specific resources, such as power aware routing protocol and load aware protocol, which is useful for us.

A. Proactive Routing Protocols

A route to all destinations is maintained using control messages which puts additional load on the nodes operating. So it creates a wastage of bandwidth of packets again to fetch the control messages it hampers the performance of the nodes too. Since, proactive routing protocol is not suitable for the packet transmission in large numbers of nodes in a network. Proactive routing protocols are not suitable for larger networks. As it needs to maintain a table for the routes comprising of all the routes. Ex: DSDV.

B. Reactive Routing Protocols

Routes are detected when there is a need of packet transmission. So, it reduces the overhead on the nodes locating in between the source and base station. So there is no need to search for and maintain the routes where there is no demand. Thus Reactive routing protocols are very useful and demanding when the resource is limited and throughput is main concern of the environment. However, source node has to wait for the final route from source to destination is found. So, this approach is best suited for the environment where the traffic is light, and resource is limited. Ex. DSR, and AODV.

C. Hybrid Routing

The Ad Hoc network can be implemented using hybrid routing protocol. In the Hybrid Routing Protocol we can merge one or two protocol for the enhancement of the transmission strategy. We can merge LEACH protocol and AODV both in a single area, it no doubt it will increase the complexity to organize the network but will increase the performance and throughput of the system. Again we can implement the task combining both proactive and reactive routing protocols to balance and control the overhead.

D. Analysis

There are two approaches for the packet transmission:

1) Network Environment Parameters like network size connectivity, mobility etc.
2) General Performance Metrics of Routing Protocols like message delivery ratio, control overhead/load, hops count, end to end time difference, etc.

In this paper control overhead and end to end time difference performance parameters are considered.

III.AODV PROTOCOL

AODV is used to make the routes for the new destinations, and there is no need to the non active nodes to keep details of the destination routes. Also, AODV routing protocol responds for the link breakages between the nodes. Since, AODV protocol is useful for the dynamic and mobile transmission of the packets using mobile nodes transmission. Control messages used in

AODV are:

1) Route Request Message (RREQ)
2) Route Reply Message (RREP)

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3) Route Error Message (RERR)
4) Route Reply Acknowledgment (RREP-ACK) Message
5) HELLO Messages

A. Route discovery

When a source node wants to send the message to the destination or base station and it does know the route to it broadcast the request for the route which is accompanied by neighbor and then it process it further to the destination.

If the nodes doesn't have a valid route to the destination its initiates a path discovery process to locate the other node. It broadcast a route request (RREQ) control packet to the neighboring node and then forwards the request to their neighboring node, and then furthers forward it to the destination node.

The AODV protocol uses destination sequence numbers to ensure that all routes contain the most recent and updated route information. Each node carries its own sequence number.

During the transmission process the RREQ intermediary nodes keeps the address of the neighbor from which the initialization of the packet is received in the table, thereby establishing a reverse path. Once the RREQ reaches the destination or an intermediate node with a fresh enough route, the destination or the intermediate node responds by unicasting a route reply (RREP) control packet back to the neighbor from which first received the RREQ.

B. Route Maintenance

When a route is discovered between a source node and destination it is maintained for the time needed by the source node. The destination node or some in between node moves, the node transmission of the break initiates Route Error (RERR) message to the affected active upstream neighbours/nodes. This process is repeated till the source is reached, when source receives the RERR, It stops sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still needed.

IV. PROPOSED METHODOLOGY

This section describes the method to show the difference between the Enhanced-AODV and common AODV routing protocols during transmission with the following simple topology.

Let us take the example of 4 nodes in the grid and method is shown in the table-1. According to the scenario at the beginning of the transmission of nodes, two pairs are not in interference with each other. At 5 s, node 2 moves towards the direction of Node 0 with a speed of 5m/s(assumption), the distance between Node 0 and node2 becomes smaller and smaller, and at time 8s these two node begin to be in each other's range of carrier sensor, which means that there two nodes begin to share the same channel. The maximum bandwidth of the channel is around 3.64 Mbps.

In AODV, where there is no consideration for the load as per requirement, when Node2 is in the interference range of Node 0, It send the packet to it as proposed , now if there is some other node say Node3 begins to transfer the packet at the same time it creates a congestion in the node2 to receive the data from both side at the same time, again extra load due to that is also created on them because coincidence of the time, now E-AODV which is proposed consist of the properties of LEACH Protocol and AODV at the time, now first of all in between the group of nodes, a head is decided using the probability formula as under:

Temp<= (p/ (1-p*mod(r, round (1/p)))*S(i).E/mod(1/p))

Where,

Temp=temporary chosen node;

R=no. of rounds;

P=probability of nodes in a cluster of nodes

when the cluster head is chosen, all the adjacent nodes who are broadcasting the request for the route to the base station, is first filtered by the cluster head and then the packet is transferred to the base station, again if the number of nodes associated with the cluster head exceeds the fixed number of rounds say 10 transmission is reached then the cluster head shifts the load to its adjacent clustering head node in the time interval of 5*10=50 seconds, it switches the cluster head after that round of transmission,

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Table 1: Scenario Descriptions for proposed topology position

Position (50,250)(50,100)(650,250)(50,100)						
Node ID	Time that node begins to move 5s	Movement direction	Movement speed	Duration	Traffic type CBR	Required data rate
Node 2	(550,250)	Node 1- node 0 Node 2- Node 3	10m/s	6s-18s 6s-18s	CBR CBR	1.8Mbps 2Mbps

In the topology, there were 16 nodes and the simulation environment was as described in Table1. The area size is 100 m * 100m, and 50 nodes are in this area. 50 s is added at the beginning of each simulation to stabilize the mobility model. Every simulation runs 5*10s in total. The average of tens runs is denoted by a single data point with same traffic models but differently randomly generated mobility scenarios. To confirm that the comparisons are done on fair parameters, same mobility and traffic scenarios are used in both the AODV and the E-AODV routing protocols.

V. SIMULATION TRAFFIC PATTERN

The mobility of the node is shown by the shifting of dots with the circle which denotes a node in a network. MATLAB 2014A provides some tools to change the colour of the node, which is used to show the different criteria. The traffic type in the application layer is CBR with packet size of 512 bytes and in transport layer User Datagram Protocol (UDP) is used. The traffic pattern that used in the simulation is shown in Table 2. It is the same as what the Reference [4] uses.

Table 2: Simulation traffic pattern

Traffic flow	Source and destination node	Start time(s)	End time(s)
Session 1	3-4	53	174
Session 2	7-8	144	280
Session 3	4-5	290	315
Session 4	5-7	305	475
Session 5	5-6	445	483

In the sequence of data sessions, the flow of packet data is made in such as way that follows greater interference of impact when the session coincides. The source node and destination node routes are chosen randomly by using function.

VI. SIMULATION RESULTS AND ANALYSIS

For the comparison of routing protocol two parameters which is Average transmission for the packet from one node to another , and the number of packets which put load in the cluster node is compared to evaluate the effective load on node between AODV and the Enhanced-AODV routing protocols.

A. Data Rate and Load on the Node

In a group of data rates ranging from 50 kbps to 1800 kbps is applied. The mobility of a particular node is assigned with a pause time of 2 sec seconds and the maximum speed of node 10m/s, now when the packet is send from one of the node to the probable cluster head it is considered as a first round of the transmission. If the node which is taking the packets from the initiated node overcomes the limit of the node, it is stops taking the further packet by sending the new sequence number of adjacent node which will be the new cluster head to continue the packet transmission.

1) *Packet Delivery Ratio:* From figure.1 we can clearly see that delivery ratio decreases with the increase of the data transmission no matter whether we use the E-AODV routing protocol or the AODV routing protocol, this is due to lack of availability of the node receiving the packets to further transmit to the destination.

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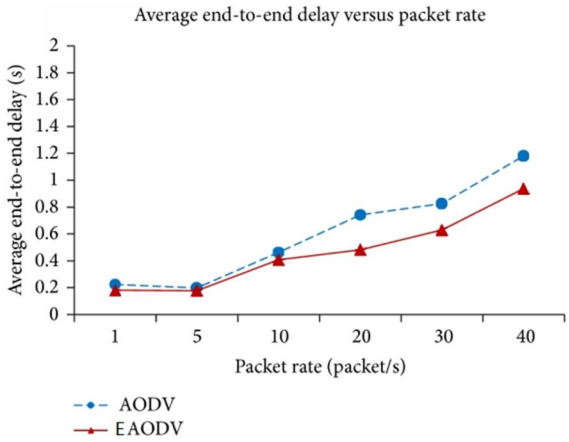

Figure 1:Packet delivery ratio

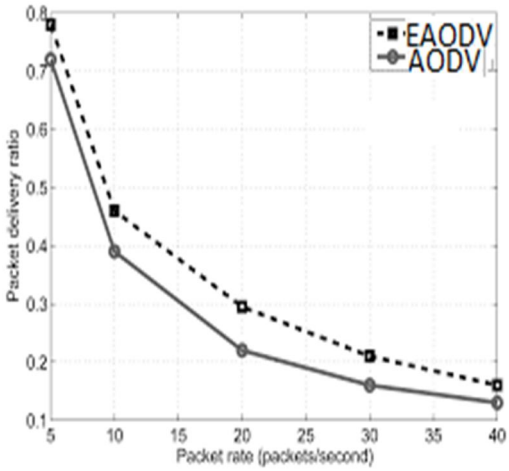

Figure 2: Average end-to-end delay versus packet rate

This is because when the data sending rate increases then the packet receiving node must be there to receive it and to further transfer it to the destination route, but if the data is send continuously with a single cluster head or route it will decay the energy of the node in between the source and destination node, so in spite of having live node, the network transmission stops after some time, so keep it alive since the last node is dead, the Load of the node has to be balanced with the adjacent node in the network of nodes the packet delivery ratio in E-AODV always lower than the AODV because the source node takes more time to find a suitable route and head in the available network, and in E-AODV if the source is not responded from the destination, source will keep on sending the packets to the sensing ranging nodes of the source it will cause the drops in the delivery ratio during this period of time, the source which keeps on sending packets from the application layer of the node, at the end of the queue when the queue is full. So, the traffic session is paused for some time say .5s and source node is responded with the new sequence number of the new node.

So as per the above discussion the packet delivery ratio with the E- AODV routing protocol is lower than the AODV routing protocol reason is that E-AODV has been implemented with more routing protocol to follow while transmission. Actually, if the packet is delivered to the destination continuously from the same route Load will increase on the particular number of nodes. The reason is that if these packets are sent from number of nodes following the same path of the route it will create congestion on the network too. In other word, E-AODV routing protocol also helps to control the packets, which are more prone to be congested during the transmission of packets.

2) *Average end to end delay:* From the figure2 we can see that AODV routing protocol is showing good result as per the transmission of packets when the data rate is low below 600Kbps. The EAODV routing protocol got higher average from node to destination rate as the intermediate node are not associated from the cluster head to base station and there is also no

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interference of intermediate nodes, which is countered in AODV routing protocol at low data rate.

Another reason that can be with E-AODV routing protocol, the number of packets sent by the source node is as it is sent to the destined node, dropping rate of the packet is very low as each center node is loaded with balanced number of packets and thus it keeps the center node fresh and uncongested.

The E-AODV routing protocol includes Hello messages which has higher priority are always transmitted first and data packets are lined nodes. In AODV routing protocol, when the traffic is light in the network, no matter on which route the flow of traffic focused to, the route chosen can provide enough data rate at most of the time. So, the consequence of this is that delay in the transfer of packet is low in AODV as compared to E-AODV with a low data rate. If we can take more time for simulation for each data rate comparatively accurate results can be found. Due to the above reasons delay in packet transfer in E-AODV is higher than AODV at low data rate. The average end to end delay of the E-AODV is always below 240ms ,whereas, the end to end delay of the AODV increases badly when the data rate of each traffic flow increases from 600 kbps to 1200 kbps. It shows that networks with the E-AODV routing protocol can provide lower end to end delay for traffic flows than the AODV since the E-AODV always choose to find a route with satisfying data rate. During the transmission, the load of the node involving in the traffic is monitored in the E-AODV routing protocol. When the load at at the center exceeds the limit as it is set before, the traffic stopped. So in AODV protocol, the average end to end delay is minimum but the load on every node which is not even transm
itting or involved in the route has to burn its energy.

B. Maximum Speed of a Moving Node

As per the simulations the data rate is fixed at 1200kbps. The maximum node moving speed is increased to see the behaviours of the AODV and the E AODV in a fairly high mobility mode. Speed of the node is ranging from 1m/s to 20 m/s. The results are shown in terms of average delay in node (cluster head) to node (cluster head) transmission. Figure 3 and figure4 shows the average differences in the packet delivery ratio from node to node and normalized routing load .

1) *Packet Delivery Ratio:* In figure 3 with low max moving speed the packet delivery ratio in E-AODV are higher than the AODV but with the increase of mobility speed the performance is lower than AODV. When the speed of the node increase to 20 m/s half of the packet dropped due the that in E-AODV. The reason that why more packets are dropped in E-AODV and how they are dropped has been explained in the previous part of this section:

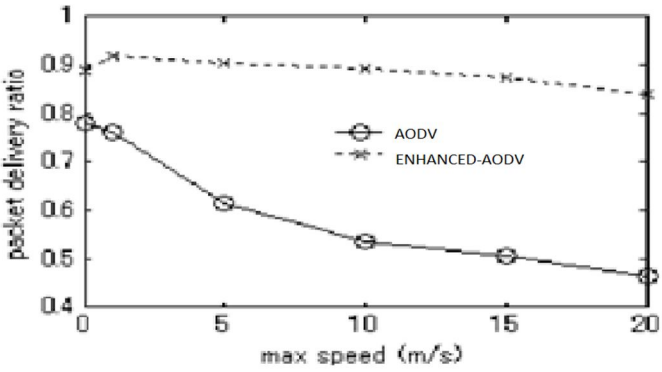

Figure 3: Packet Delivery Ratio and Max Speed graph

VII. CONCLUSION

In this paper, the description is given about the importance of
effective load on every node in terms of packet delivery ratio and average effect of load on the number of round to be done in a transmission of a packet routing in Mobile Ad-Hoc networks, and the approach taken. After observing the simulation and analyzing the data, it is found that when the load of the node is balanced then the network based routing protocol works in efficient way no matter traffic on the network is high or low. This load balance plays important role for real time transmissions. When the traffic in the transmission is high on the network, a particular cluster head is loaded so much from a single route of transmission that its energy dies so rapidly and the network system dies. E-AODV protocol works well and shows the importance of Load Balancing through different parameters such as time delay, energy of the particular node, bandwidth of the packet and its size, and lastly its effects when the traffic on the network is relatively high. People who work on the area of ad hoc networks with the aim of improving in terms of reduced average round of packet transmission and node to destination route load on intermediate node.

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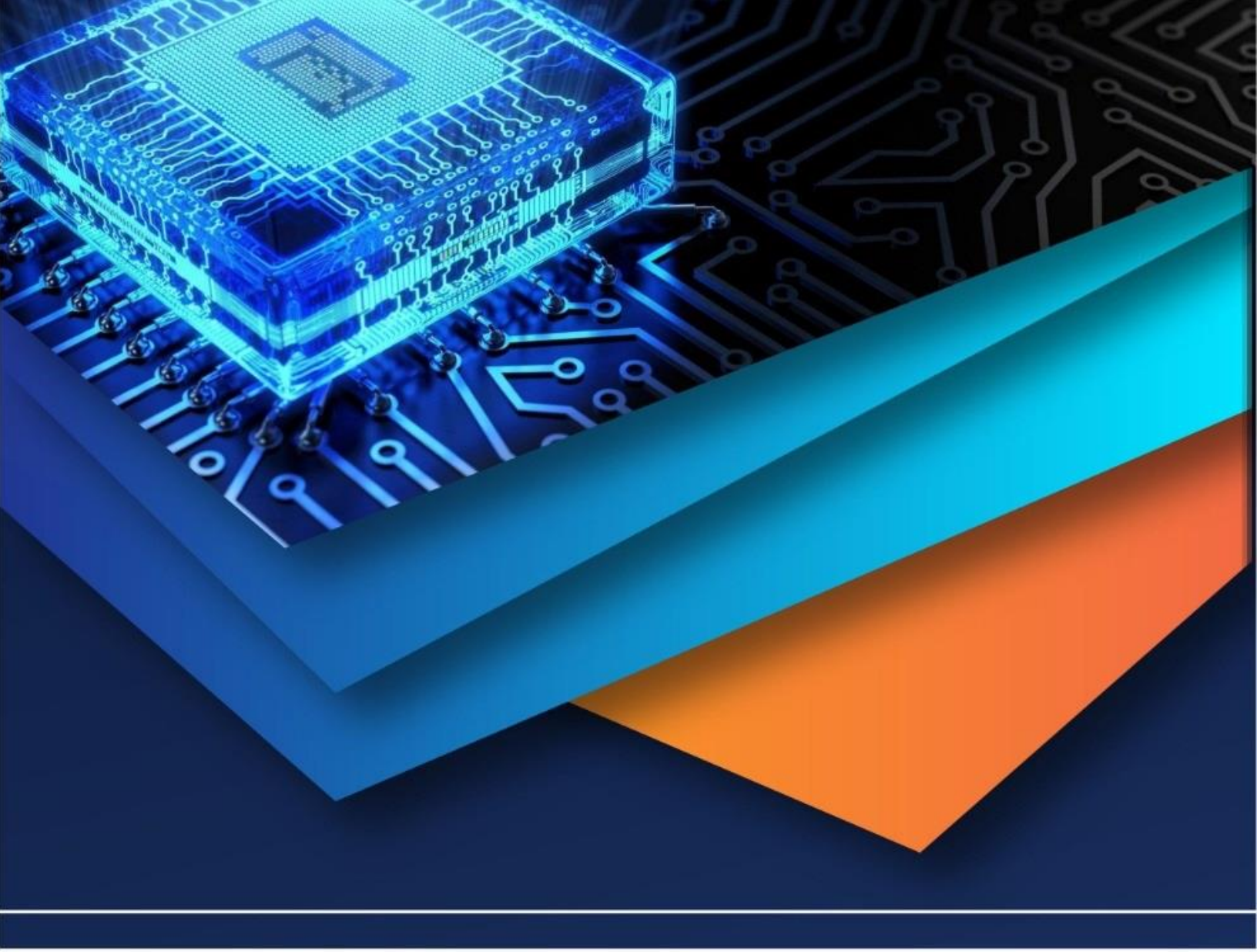

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