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A Survey on Routing Protocols of MANETs using Mobility Models for Multimedia Applications

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Abstract— A mobile ad hoc network (MANET) consists of mobile wireless nodes. The communication between these mobile nodes is carried out without any centralized control. MANET is a self-organized and self-configurable network where the mobile nodes move arbitrarily. The main classes of MANET routing protocols are Proactive, Reactive and Hybrid. In this paper we compare performance of Proactive routing protocol by focusing on Optimized Link State Routing (OLSR) and Reactive Routing Protocol by focusing on Ad Hoc on Demand Distance Vector (AODV) and Gathering-based Routing Protocol (GRP). We study both the availability and the duration probability of arousing path that is subject to link failures caused by node mobility. In particular, we focus on the case where the network nodes move according to the Vector mobility model and Random Way Point mobility model, and we derive both exact and simple and approximate expressions of these probabilities. By obtained results, we study the problem of selecting an optimal route in terms of path availability. Finally, we propose an approach to improve the efficiency of Routing protocols using mobility model.
Keywords— MANET, AODV, OLSR, GRP, Mobility Model

I. INTRODUCTION

Mobile Ad hoc Network (MANET) is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. These networks are fully distributed, and can work at any place without the help of any infrastructure. This property makes these networks highly exile and robust.

In particular, mobile ad hoc networks (MANETs) enable users to maintain connectivity to the fixed network or exchange information when no infrastructure, such as a base station or an access point, is available. This is achieved through multi-hop communications, which allow a node to reach far away destinations by using intermediate nodes as relays. The

selection and maintenance of a multi-hop path, however, is a fundamental problem in MANETs. Node mobility,

Signal interference and power outages make the network topology frequently change; as a consequence, the links along a path may fail and an alternate path must be found.

To avoid the degradation of the system performance, several solutions have been proposed in the literature, taking into account various metrics of interest. A method that has been advocated to improve routing efficiency is to select the most stable path [1], [2], [3], [4], so as to avoid packet losses and limit the latency and overhead [5] due to path reconstruction (routing instability).

Here we focus on vector and random way point mobility model [5], and we consider nodes moving according to the vector mobility model, According to such model, each node alternates periods of movement move phase) to periods during which it pauses (pause phase); at the beginning of each move phase, a node independently selects its new direction and speed of movement [1], [2], Speed and direction are kept constant for the whole duration of the node move phase.

Figure 1: MANET

II. AD-HOC ROUTING PROTOCOLS

This section describes the main features of three protocols AODV (Ad hoc On-demand Distance Vector) [1] and OLSR (Optimized Link State Routing) [2]; GRP (Gathering-based Routing Protocol) [3]deeply studied using OPNET14.5.

A. Ad hoc On-demand Distance Vector (AODV)

AODV is an on-demand routing protocol. The AODV [9] algorithm gives an easy way to get change in the link situation. For example if a link fails notifications are sent only to the affected nodes in the network.

This notification cancels all the routes through this affected node. It builds unicast routes from source to destination and that's why the network usage is least. Since the routes are build on demand so the network traffic should be minimum. AODV does not allow keeping extra routing which is not in use [10].

If two nodes wish to establish a connection in an ad hoc network then AODV is responsible to enable them to build a multi-hop route. AODV uses Destination Sequence Numbers (DSN) to avoid counting to infinity that is why it is loop free. This is the characteristic of this algorithm. When a node send request to a destination, it sends its DSNs together with all routing information. It also selects the most favorable route based on the sequence number [10].

There are three AODV messages i.e. Route Request (RREQs), Route Replies (RREPs), and Route Errors (RERRs) when the source node wants to create a new route to the destination, the requesting node broadcast an RREQ message in the network [9]. The RREQ message is broadcasted from source node A to the destination node B. The source node A broadcasts the RREQ message in the neighbour nodes. When the neighbour nodes receive the RREQ message it creates a reverse route to the source node A. This neighbour node is the next hop to the source node A.

The hop count of the RREQ is incremented by one. The neighbour node will check if it has an active route to the destination or not. If it has a route so it will forward a RREP to the source node A. If it does not have an active route to the destination it will broadcast the RREQ message in the network again with an incremented hop count value, then it procedure for finding the destination node B. The RREQ message is flooded in the network in searching for finding the destination node B. The intermediate nodes can reply to the RREQ message only if they have the destination sequence number (DSN) equal to or greater than the number contained in the packet header of RREQ.

The intermediate nodes forward the RREQ message to the neighbor nodes and record the address of these nodes in their routing cache.

This information will be used to make a reverse path for RREP message from the destination node. The RREP reached to the originator of the request. This route is only available by unicasting a RREP back to the source. The nodes receiving these messages are cached from originator of the RREQ to all the nodes.

When a link is failed an RERR message is generated. RERR message contains information about nodes that are not reachable. The IP addresses of all the nodes which are as their next hop to the destination.

B. Optimized Link State Routing (OLSR)

It is a proactive routing protocol and is also called as table driven protocol because it permanently stores and updates its routing table. OLSR [2][8] keeps track of routing table in order to provide a route if needed. OLSR can be implemented in any ad hoc network. Due to its nature OLSR is called as proactive routing protocol. Multipoint relay (MPR) nodes in the network do not broadcast the route packets. These MPR nodes can be selected in the neighbor of source node. Each node in the network keeps a list of MPR nodes.

This MPR selector is obtained from HELLO packets sending between in its neighbor nodes. These routes are built before any source node intends to send a message to a specified destination. Each and every node in the network keeps a routing table. This is the reason the routing overhead for OLSR [8] is minimum than other reactive routing protocols and it provide a shortest route to the destination in the network. There is no need to build the new routes, as the existing in use route does not increase enough routing overhead. It reduces the route discovery delay.

C. Gathering-based Routing Protocol (GRP)

Gathering-based Routing Protocol [9] combines the advantages of Proactive Routing Protocol (PRP) and of Reactive Routing protocol (RRP). Supporting the delay sensitive data such as voice and video but it consumes a great portion of the network capacity. While RRP is not suitable for real-time communication, the advantage of this approach is it can dramatically reduce routing

overhead when a network is relatively static and the active traffic is light. However, the source node has to wait until a route to the destination can be discovered, increasing the response time.

The goal of the proposed routing protocol (GRP) [5] is to rapidly gather network information at a source node without spending a large amount of overheads. It offers an efficient framework that can simultaneously draw on the strengths of PRP and RRP.

D. Destination Sequenced Distance Vector (DSDV)

DSDV [9] is a hop-by-hop distance vector routing protocol requiring each node to periodically broadcast routing updates based on the idea of classical Bellman-Ford Routing algorithm. Each node maintains a routing table listing the "next hop" for each reachable destination, number of hops to reach destination and the sequence number assigned by destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid loop formation. The stations periodically transmit their routing tables to their immediate neighbours. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven. The routing table updates can be sent in two ways: a "full dump" or an "incremental" update.It was developed by C. Perkins and P.Bhagwat in 1994. The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently. While DSDV itself does not appear to be much used today, other protocols have used similar techniques. The best-known sequenced distance vector protocol is AODV, which, by virtue of being a reactive protocol, can use simpler sequencing heuristics. Babel is an attempt at making DSDV more robust, more efficient and more widely applicable while staying within the framework of proactive protocols.

E. Dynamic Source Routing (DSR)

DSR [10] is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes.

It allows nodes to dynamically discover a source route across multiple network hops to any destination in the ad hoc network. Each data packet sent then carries in its header the complete ordered list of nodes through which the packet must pass, allowing packet routing to be a trivially loop free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. With the inclusion of this source route in the header of each data packet, other nodes forwarding or overhearing any of the packets may easily cache this routing information for future use.

Dynamic source routing protocol (DSR) is an on-demand protocol designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages required in the table-driven approach. The major difference between this and the other on-demand routing protocols is that it is beacon-less and hence does not require periodic hello packet (beacon) transmissions, which are used by a node to inform its neighbours of its presence.

The basic approach of this protocol (and all other on-demand routing protocols) during the route construction phase is to establish a route by flooding Route Request packets in the network. The destination node, on receiving a Route Request packet, responds by sending a Route Reply packet back to the source, which carries the route traversed by the Route Request packet received.

III.RELATED WORK

Gupta et al. discuss evaluating effect of mobility on routing protocols ADOV , DSDV ,DSR and OLSR in terms of packet delivery ratio, average end-to-end delay and also evaluate normalize routing load[11].There is a brief over view on various routing protocols and mobile models .The performance can be evaluated by AODV ,DSDV, DSR and OLSR ,in the Presence of Random Way Point Mobility Model(RWP).It represents an increase in the node density has a similar impact on all routing protocols it means degradation of performance.

Kumar et al. demonstrates the scenarios on to analyse movements of various node on random way point, random walk, Manhattan grid model etc .Reference Point group Mobility Model (RPGM) is used in situations where nodes move in a group and that has been found required situations like disaster and vehicle networks [12].the simulation shows that MANET routing algorithms behave significantly different under the mobility scenarios designed for the same platform.

Singh et al. In Mobile Ad-hoc Network remains winsome due to obtain better performance and scalability [13]. Mobile ad hoc network is an unstructured self-forming radio mesh of moving nodes. There is no median approach for interaction of mobile nodes. In MANET nodes are mobile in nature and it became challenging to handle them while preserving the energy. Misbehaviour, Mobility, Congestion are some factors that always degrade the performance of network. In this paper we propose a WSEEC (Weight age based Secure Energy Efficient Clustering) algorithmic approach towards energy efficient clustering and security of nodes.The aim of this algorithm is to build secure and energy efficient cluster head. Where values of each node rely is calculated to know the behaviour of the node. The performance of proposed WSEEC algorithm is compared with WCA under five metric such as a Network life time, Energy consumption, throughput, delay and packet delivery ratio.

Gupta et al. describe the comparison and study on reduced energy consumption by using multipath protocol and performance which is evaluated by performance metrics in case of AOMDV and energy based AOMDV [14]. Now here DREAM protocol is used with AOMDV to finding location of mobile nodes but not with energy but here measures their performance with both multipath protocols. Reason behind the enhancement of AOMDV to AOMDV with energy is to discover energy efficient paths between each node by calculating residual energy of each node by the use of GPS (Global Research Paper on Comparison between Energy Efficient Routing Protocol with Energy and positioning system) select the path consisting of minimum nodal residual energy and on the basis of descending order of nodal residual energy select all the routes. After this selection, a new route with maximum residual energy is selected to forward rest of the data packets. These results in the improvement of the individual node's battery power consumption and enhance the entire network lifetime. In future we also measure the performance of DREAM protocol with energy factor and compare the results with normal AOMDV location based routing. If the performance of energy based multipath routing protocol is better than existing three then definitely it reduces energy consumption and enhance network life time.

Singh et al. describe the User datagram protocol (UDP) and transmission control protocol (TCP) are two popular transport layer protocols in infrastructure networks [15]. The behavior of these transport layer protocol with different mobility models and routing protocols is still not very clear. In this paper, compared the performance of user datagram protocol (UDP) and transmission control protocol (TCP) in mobile ad hoc network (MANET) for optimized link state routing (OLSR), and temporarily ordered routing algorithm (TORA) routing protocols with different mobility models like random waypoint, reference point group, and Manhattan mobility models. Simulations is to be done in NS2 to analyses results using the performance metrics, such as throughput, packet delivery ratio, and end-to-end delay by for different types of data traffic and mobility models. The MANET performance is analyses under the effect of simulation time, number of nodes, and speed of mobile nodes. Our work indicates that TCP performs well for throughput in some mobility model and different routing protocols than UDP. The results presented in this paper clearly indicate that the different protocols behave differently under different parameters.

S. R. Biradar et al. in their paper [16] they compare the performance of two on-demand routing protocols for mobile ad hoc networks Dynamic Source Routing (DSR) and Ad Hoc On-Demand Distance Vector Routing (AODV). They demonstrate that even though DSR and AODV both are on-demand protocol, the differences in the protocol mechanics can lead to significant performance differentials. The performance differentials are analyzed using varying mobility.

Maurya et al. in routing protocol is used to discover routes between mobile hosts to facilitate communication inside the network with a minimum of overhead and bandwidth consumption [17]. Various routing protocols have been proposed by researchers for mobile ad-hoc networks in the recent past. This paper presents performance evaluation and comparison of three different On-Demand routing protocols for Mobile Ad-Hoc Networks i.e. Ad hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR), and Dynamic MANET On-demand (DYMO) protocols in variable pause times. We have used random waypoint mobility model to design the network and performed simulations by using QualNet version 5.0 Simulator from Scalable Networks for CBR traffic in MANET. Performance of AODV, DSR and DYMO are evaluated based on Average end-to-end delay, Packet delivery ratio, Throughput and Average Jitter. In mobility management the random way point is a random model for the movement of mobile users, and how their location, velocity and acceleration change over time. Mobility models are used for simulation purposes when new network protocols are evaluated. In random-based mobility simulation models, the mobile nodes move randomly and freely without restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes.

IV.MOBILITY MODELS

In MANETs, mobile nodes roam around the network area. It is hard to model the actual node mobility in a way that captures real life user mobility patterns. Mobility models are designed to evaluate the performance of ad-hoc networks and characterize the

movements of real mobile node in which variation in speed and direction must occur during regular time interval. Therefore, many researchers attempted to design approximate mobility models to resemble real node movements in MANETs such as follows:

4.1 Random way point mobility model:- In this model, the position of each MN is randomly chosen within a fixed area and then moves to the selected position in linear form with random speed. This movement has to stop with a certain period called pause time before starting the next movement. The pause time is determined by model initialization and its speed is uniformly distributed between [Min Speed, Max Speed].

4.2 Random walk mobility model :- In this mobility model mobile host moves from current location to new location by choosing randomly direction and speed from the predefined ranges between min speed and max speed.

*4.3 Group mobility model:-*Group mobility models that represent multiple MNs whose actions are completely independent of each other. In this mobile nodes moves in groups. In an ad hoc network, however, there are many situations where it is necessary to model the behavior of MNs as they move together. For example, a group of soldiers in a military scenario may be assigned the task of searching a particular plot of land in order to destroy land mines, capture enemy attackers, or simply work together in a cooperative manner to accomplish a common goal.

*4.4 Pursue mobility model:-*The Pursue Model is basically designed to mimic the pursuit of a single node by a group of nodes. The direction of motion of the runaway node follows the SMOOTH-VARIATION motion as described earlier. In this model all nodes have a randomly varying speed between zero and Max Speed. The nodes in pursuit of the runaway node have a direction that an instant will be in a straight line towards the runaway node.

*4.5 Vector mobility model:-*This model is used to avoid the unrealistic behavior which is physically impossible. By remembering mobility state of a node and allowing only partial changes in the current mobility state, natural motions can be reproduced. Advantages of this model are: simplification of position updates, ease of implementation and opportunity for mobility prediction.

*4.6 Pursue shortest mobility model:-*Pursue Shortest model basically based on the pursue model. In this model, every node attempts to chase a particular node moving towards a particular target but starts from the nearest segment. Every node chooses a shortest path to get its target. In this model every node chooses the nearest segment to reach its target. But in the Pursue model every node.

*4.7 Gauss-Markov Mobility Model:-*The Gauss-Markov Mobility Model was first introduced by Liang and Haas and widely utilized .In this model, the velocity of mobile node is assumed to be correlated over time and modeled as a Gauss-Markov stochastic process.

*4.8 Reference Point Group Mobility model:-*The Reference Point Group Mobility model (RPGM) has a special mobile node known as the logical centre. The motion of this mobile node defines the entire group's features like location, speed, direction, acceleration, etc. Thus, the group trajectory is determined by providing a path for the centre. Generally nodes are uniformly distributed within the geographic range of a group. Each node is assigned a reference point which follows the group movement. This reference point allows independent random motion behavior for each node, in addition to the group motion.

*4.9 Manhattan Mobility Model:-*Manhattan Mobility Model is used to emulate the movement pattern of mobile nodes on streets. It can be useful in modeling movement in an urban area. In this network maps are used. Maps contain a number of horizontal and vertical streets. The mobile nodes are restricted to move along horizontal and vertical streets on the map. At an intersection of a horizontal and a vertical street, the mobile node can move left, right, straight with certain probability. The speed of a mobile node at some time is dependent on its previous time speed and on the speed of the front node in the same direction.

4.10 Chain mobility model: - The Chain model is not a model itself but a concatenation of implemented models (e.g., Random Waypoint, Manhattan, RPGM, etc.). In some cases it is necessary to model scenarios in which mobile nodes behave in different ways depending on time and position.

V. PREPOSED WORK

As discussed the main aim of my research project is to evaluate the quality of service (QoS) requirements for the multimedia applications across the wireless LAN networks and in this context OPNET modeller will be used as the simulation tool. Network Simulation OPNET (optimized Network Engineering Tool) Modeler version 14.5 in our evaluation. The OPNET is a discrete event driven simulator. It simulates the network graphically and its graphical editors mirror the structure of actual networks and network components. The modeler uses object-oriented modeling approach. The nodes and protocols are modeled as classes with inheritance

and specialization.

According to related work TCP provides end-to-end data delivery across the wired networks and proved to be an efficient means of data transmission but it abruptly fails in case of wireless networks like MANETs and this is mainly due to the reason that TCP can't work in few conditions like packet loss or delay, where in a general MANET packet delivery delay and packet losses are simply encouraged.

The proposed simulation parameters are summarized in table 1.

Table 1: Network Parameters

Parameter	Value
Simulator	Opnet 14.5
Area	3.5×3.5 Km
Wireless MAC	802.11
Mobility Model	Vector Mobility,Random Waypoint Mobility
Data Rate	11 Mbps
Application	Multimedia

The following Performance Metrics has been proposed for evaluating the performance of various MANET routing protocols:

A. Network Load

The statistic represents the total data traffic (in bits/sec) received by the entire WLAN BSS from the higher layers of the MACs that is accepted and queued for transmission

B. End-to-end Delay

Represents the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layer. This delay includes medium access delay at the source MAC, reception of all the fragments individually, and transfers of the frames via access point, if access point functionality is enabled.

C. Throughput

Represents the total number of bits (inbits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

VI. CONCLUSION AND FUTURE SCOPE

The evaluation of most of these proposals has been performed with the aid of various network simulators. Most of tools, such as the OPNET, ns-2 or the GLOMOSIM, make the use of synthetic models for mobility and data patterns. The mobility models that are commonly used to simulate MANET scan is classified into two main categories: individual-based and group-based. An individual-based model describes node mobility independently of any other nodes. With group-based mobility models, individual nodes movement depends on the movement of close-by nodes. According to reviewers shows the impact of group mobility on the performance of a MANET and presents the critical factors that affect its behaviour, energy and performance. The mobility of the nodes affects the number of average connected paths, which in turn affect the performance of the routing algorithm.

In future, utilizing these performances we can enhance the performance of routing protocol that is based on mobility models for multimedia application so that suitably provide data integrity as well as data delivery in highly random mobility network.

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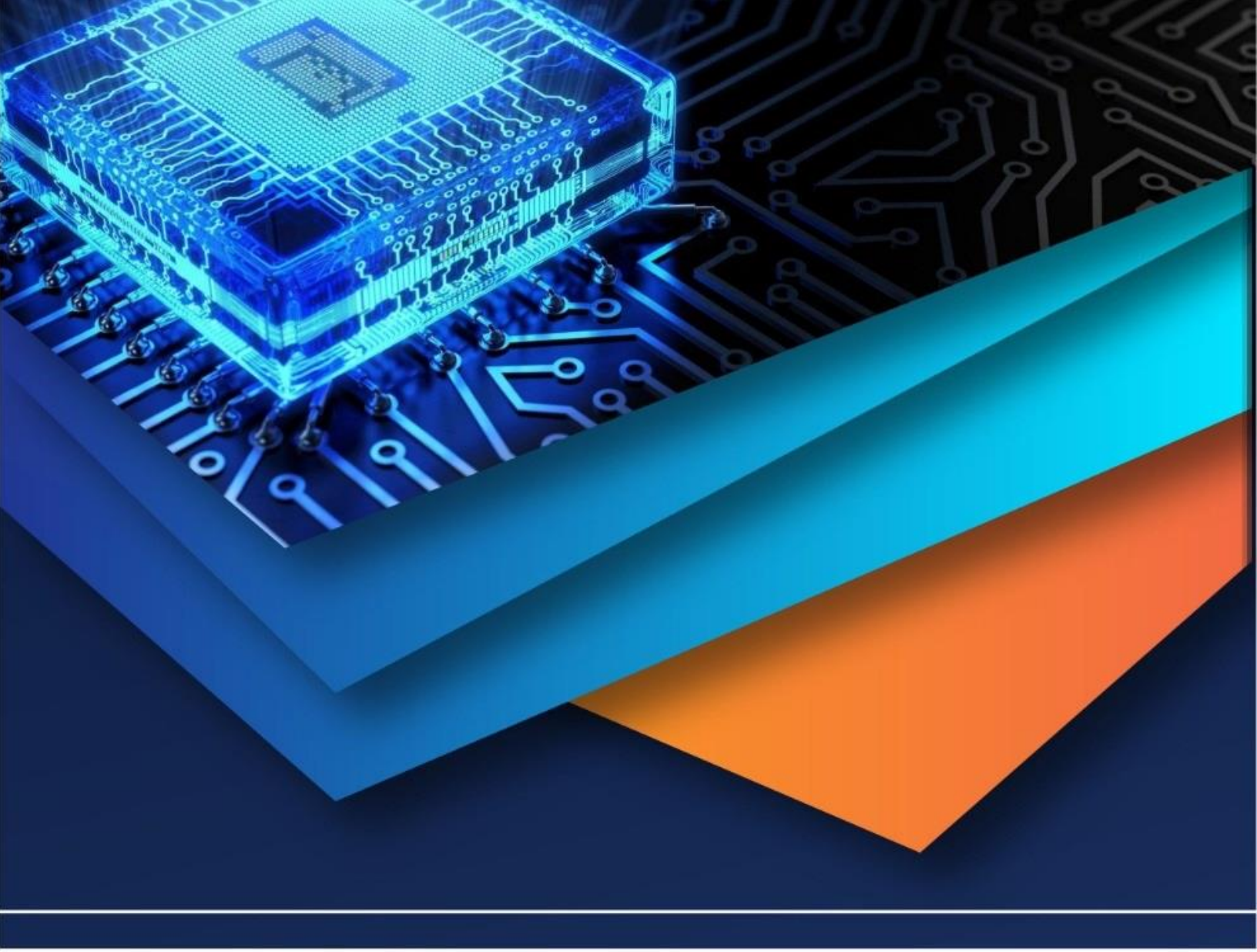

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