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Analysis Performance of Different Routing Protocols for MANETs using NS2 Simulator

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Abstract: ***To put it simply, a Mobile Ad-Hoc Network (MANET) is indeed a network of wireless mobile hosts that have formed temporarily without the use of any dedicated infrastructure or centralized administration. The network's nodes are self-organizing & self-configuring because of their mobility. The hosts also serve as routers. Their job is to route information to and from other network nodes. Routing protocols are essential in MANETs because they determine the best ways to get from one node to another. Any ad hoc network's routing protocol should be designed with the ever-evolving topology in mind. For this reason, it is important to set up a path between any two nodes that uses as little bandwidth as possible and as few hops as possible in the routing process. Due to the transient and ever-changing nature of mobile ad hoc networks, designing suitable routing protocols is difficult. For MANETs, routing protocols can be either proactive or reactive. Features and difficulties of MANETs are discussed in this work. Furthermore, both proactive and reactive routing systems, as described earlier, are discussed in detail. Additionally, DSDV, DSR, and AODV are compared with one another in terms of attributes and performance. Finally, certain articles that have dealt with routing in MANET are critically examined.***

Keywords: Mobile Ad Hoc Networks; Proactive Routing; Reactive Routing; Dedicated Source Distance Vector Routing; Ad Hoc On-Demand Distance Vector

I. INTRODUCTION

MANET stands for mobile ad hoc network, which refers to a network of mobile nodes that may connect with one another without the need for infrastructure or centralized control. This type of network makes it possible to quickly create as well as implement a large field of communication, which is exactly what we need in several scenarios, such as a natural catastrophe or battlefield surveillance[1], in which there is no centralized infrastructure as well as all nodes are mobile and require connected to each other in a way that is both dynamic and arbitrary. This type of network allows for the creation and deployment of a wide communication field quickly. However, in order to account for the dispersed nature of the wireless nodes and the dearth of available energy resources, this kind of network needs to implement particular protocols.

Mobile nodes that are able to interact with each other and move independently of one another. Mobile Ad-hoc Networks, often known as MANETs[2], are one of the most rapidly developing types of networks. Nodes serve both as hosts and as routers in the network. Because any node inside, since nodes in a Manet can move in any direction and frequently establish new links with other devices, each one must be able to forward traffic that is unconnected to its own. usage, and is therefore considered a router. In ad hoc networks, the nodes are generated on the fly, and there is no requirement for which was before or an already existing infrastructure such as an access point or ground station[3].

In a typical MANET, there is a significant degree of mobility present among the nodes, which results in quick changes in topology. Routing protocols designed expressly for MANETs, such as In order to monitor the health of the links, protocols like AODV, OLSR, TORA, as well as DYMO require regular broadcast messages from each node. A few examples of routing protocols based on topology, such as DSDV, AODV, and DYMO, make use of the neighbor table to detect broken links. This is the case in some situations[4]. The status of each node can be determined by examining the hello messages that have been received. MANETs are thought to be good prospects for a number of reasons, including the ease with which they may be used, their resilience, how quickly they can be deployed, and how little they cost. There are a number of drawbacks to MANETs, including their mobile and dynamic topology, the consistent motion of nodes, the vulnerability of safety due to the cooperation notion in MANETs, and the low compute capabilities because of the small devices used in MANETs[5]. The following is a classification of MANET routing protocols that might be done based on the technique of delivering data packets from the source to the destination:

There is a subset of routing protocols known as "unicast routing protocols" that are specifically designed to deliver data packets from a single source to a specific destination. Also known as just a one-to-one routing protocol, this is the simplest and most basic type of routing protocol[6].

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The term "multicast" refers to the practice of sending data to multiple receivers simultaneously by selecting the most efficient method to send the data across the network's multiple links and then making copies of the data once the connections between the receivers have severed. Procedures for Routing Multicast Data One definition of multicast is the transmission of a single data stream to multiple receivers simultaneously. MANET multicast routing systems use a hybrid of multicast and unicast techniques to transmit data[7].

II. LITERATURE

Siddesh et al. The primary difficulty in operating a MANET network is maintaining constant information management across all devices to guarantee efficient flow of data. Peer-to-peer communication is at the heart of a MANET, which also features self-forming and self-healing nodes. The network has several potential applications, including those related to vehicular safety, home and health monitoring systems, medical robotics, and more. This research set out to better understand the MANET infrastructure and its protocols, namely the AODV protocol, the peer selection process, and how it could be enhanced. The focus of the work is on the ETX measurements and how to incorporate them into the AODV protocol. The AODV protocol is simulated, and then the AODV-ETX protocol is simulated as well. Network Simulator 3 is used for the simulation of the proposed solution. A study of the AODV with AODV-ETX protocols is included in the work. Tabular and graphical representations of the simulation findings are provided. While the AODV-ETX offers superior features than the AODV protocol, if the number of nodes in the network grows over 20, the AODV protocol begins to look more and more attractive. When gauging performance, factors like transmission errors, packet delay, or permeability are taken into account[8].

Gagan Deep et al. VANET uses mobile ad hoc routing techniques (MANET). Geocast, topological, broadcast, geographic, or cluster-based routing protocols are VANET standards. They aren't ideal for all VANET traffic circumstances. Thus, standard VANET routing algorithms can be combined with evolutionary, trajectory, nature-inspired, and even ancient-inspired meta - heuristic algorithms algorithms to improve routing performance. In order to create a more effective routing strategy, this study proposes combining GA and ACO in three real-world VANET web traffic scenarios. The research provides a simulated experimental VANET environment and compares and contrasts the quintessential VANET routing approach with metaheuristics. Open-source networking and traffic modeling techniques are used to test the suggested approach. Three traffic scenarios were tested on SUMO using NS3.2. GAACO fared better throughout all three traffic circumstances after being compared. Realistic traffic network situations from Dehradun City include average throughput, delivery ratio, edge delay, and packet loss. The experimental results show that the GAACO algorithm outperforms PSO, ACO, and AODV routing protocols by 1.55%, 1.45%, respectively 1.23% in 3 distinct VANET network scenarios[9].

Rathi et al. MANET is a multiple-hop, autonomous, time-based wireless network that can handle Power, energy, and bandwidth are limited resources. In cellular mobile ad - hoc networks, the wormhole attack remains a major concern because it allows an attacker node to replay a packet from a remote location. In this study, we compare and contrast several different routing protocols, such as AODV, DSR, ZRP, and PA-DSR, to determine which one offers the best Quality of Service (QoS), and we assess the protocols' performance while accounting for wormhole attacker nodes. We determine network performance based on packet delivery ratio, bandwidth, packet drop, average end-to-end delay, and jitter. Finally, we evaluated the simulation's most impactful routing protocol on network metrics[10].

Russell et al. MANET is a decentralised wireless technology without pre-existing infrastructure. Each node forwards data based on its routing protocol. These procedures do the same task, but under different situations. This article simulates four routing in NS-3 at varied movement speeds & area sizes, evaluating their PDR and AETD (AETED). Performance results show what could be expected in a similar setting. Choosing a system-optimal protocol is critical[11].

Sangeetha et al. Computers connect disparate networks using various software and communication standards. Wireless networks utilizing a variety of access technologies are typically implemented as heterogeneous networks. Temporal ad hoc networks, or manets, are increasingly used. What determines the service quality is how well the network handles various types of data transmissions. Quality of service promotes more predictable network activity for improved data preservation and resource management. The efficiency of a MANET can be increased by incorporating a quality of service system. User, application, and network quality affect service quality. QoS routing assures a set of QoS parameters during route establishment. QoS routing in MANETs is real-time applications like video-on-demand, news-on-demand, online surfing, and travel information systems. This study analyzes QoS-based MANET and VANET routing protocols. Safety, emergency, or multimedia applications must be analyzed in VANET's quality of service protocols. This paper discusses optimization algorithms. MANET and VANET routing protocols must be studied based on QoS. VANET performance must be studied[12].

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III. PROPOSED METHODOLOGY

This simulation study's overarching objective is to analyze the effectiveness of reactive routing protocols such as AODV and DSR under varying conditions of node density and variable speeds of individual nodes while adhering to both IEEE 802.11 standards[13]. The simulations were carried out with the help of the scalable network simulator program NS2[14], which was used NS2 is capable of simulating Wireless Networks.

A. Ad Hoc on-Demand Distance Vector Routing (AODV)

AODV uses one-destination routing tables. DSR can store several route cache entries per destination. Without source routing, AODV uses routing entries to propagate an RREP and route packets of data to the target. AODV uses sequence numbers to determine routing information freshness and eliminate routing loops. Router packets have sequence numbers. AODV keeps timer-based statuses in each node relating routing table entries. An expired routing table entry. Each routing table item has a collection of predecessor nodes that indicate which neighbors utilize it to route data packets. If the next-hop link breaks, these nodes receive RERR packets. Each predecessor node passes the RERR onto its own predecessors, deleting the broken link's pathways. AODV RERR packets tell all sources to use a link of a failure, unlike DSR. Route error transmission in AODV could be represented as a tree whose base is the failed link and all sources using it as leaves[15].

B. Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) is indeed a table less Ad Hoc routing technology. Source-initiated protocol. This is for multi hop wireless ad hoc mobile node networks. DSR protocol doesn't need network administration or infrastructure. This self-organizes and self-configures the network. This protocol includes route discovery and management. Each node caches recently identified pathways[16]. Before sending a packet, a node examines its cache entry. If there, the packet is sent using that path. The source address is also added. If the entry isn't in the cache or has expired (after being inactive for a long period), the sender broadcasts a request for a route to all neighbours. The sender awaits the route. The sender can send/forward packets while waiting. When a route request packet is received an adjacent node, it checks its cache for the destination. If the destination route is known, the neighbour loading values back a routing reply packet; otherwise, the same request packet packet is broadcast[17].

C. Drop Tail Queue

Routers make use of a straightforward queue system in order to determine whether it is appropriate to drop individual packets. In this technique, each packet is dealt with in the same manner, and when the queue reaches its maximum capacity, freshly arriving packets are discarded until there is sufficient space in the queue to take in more incoming traffic[18].

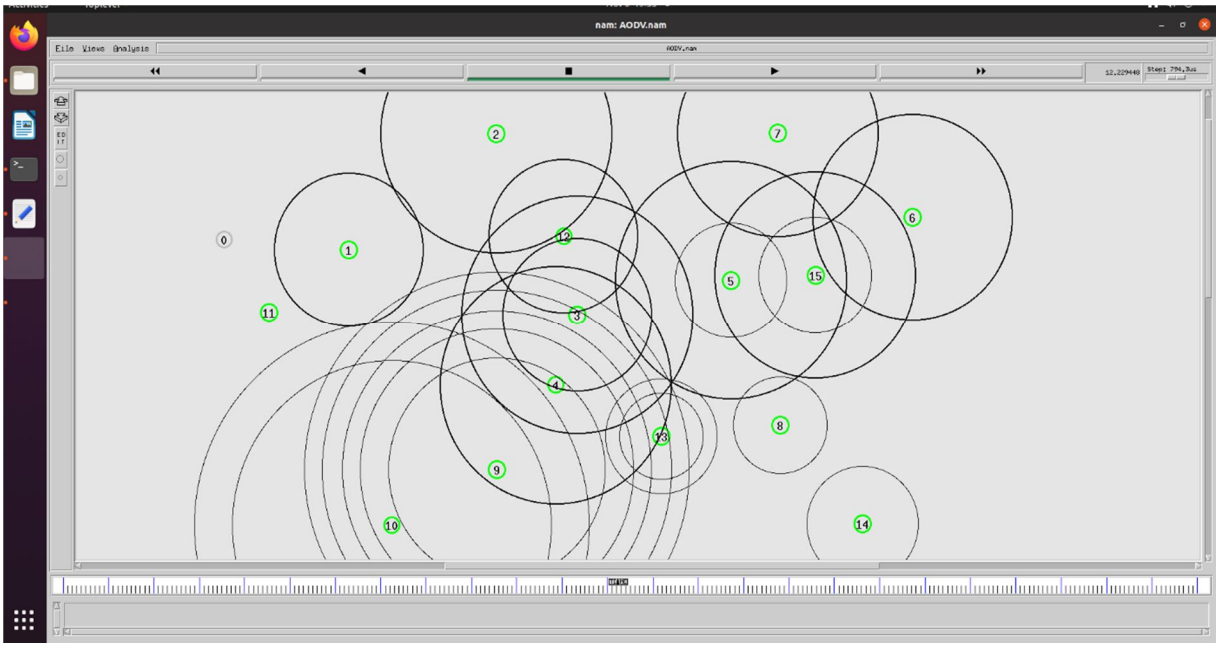


Figure 1. Simulation presentation using NAM NS2 simulator of AODV Protocol.

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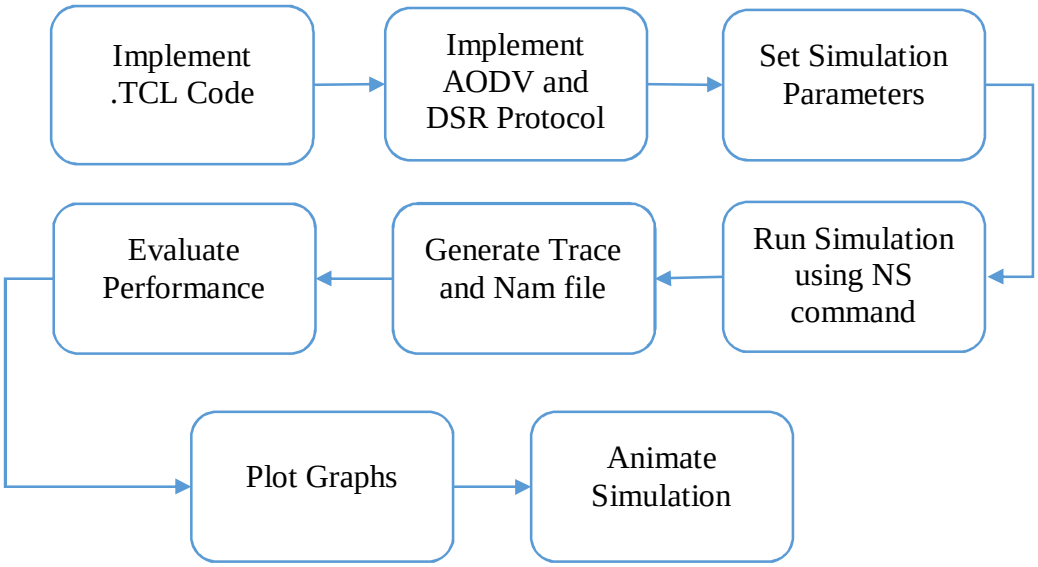


Figure 2. Flow Chart of Proposed Methodology

IV. RESULTS AND DISCUSSION

Utilize the NS2 simulator on a computer running the Ubuntu 20.02 os in order to carry out this simulation and related activities. There are two different MANET protocols that have been implemented using the.tcl programming language and are referred to as the tool command line. These protocols generate a variety of files, including trace, nam, and graph. Utilize average throughput, immediate throughput, packet delivery ratio, or residual energy while performing performance evaluations. Hardware requirements for job simulation include an Intel i-5 processor, 16 gigabytes of RAM, and 256 gigabytes of solid-state storage. As seen in table 1, there are many different parameters that are utilized to create and simulate different routing protocols. The AODV and DSR protocols have been implemented in this study. The initial energy of the nodes has been set to 50 for the calculation of the residual energy. Energy management and computation have been performed using transmission power, reception power, ideal power, and sleep power.

Table 1. Parameters used in simulation.

Algorithms	AODV, DSR
Initial Energy of Nodes	50
Transmission power	0.9
Receiving Power	0.7
Ideal power	0.6
Sleep power	0.1
Agents	TCP
File transfer protocol	FTP
FILE generate	.TCL, .NAM, .TR
Programming languages used	TCL, AWK
Performance Metrics	Average Throughput, Instant Throughput, Packet Delivery Ratio, and Residual Energy

Total simulation time used is 25 seconds and nodes used 16 due to limited memory the DSDV didn't work so not consider in this study. In table 2 present average throughput in which DSR perform well has higher throughput with 98.44 and received packets 874 with comparison of AODV received 779 packets and throughput 93.36 with 25 seconds.

Table 2. Average Throughput.

Protocol	Time (s)	Received packet	Throughput
AODV	25	779	93.36
DSR	25	874	98.44

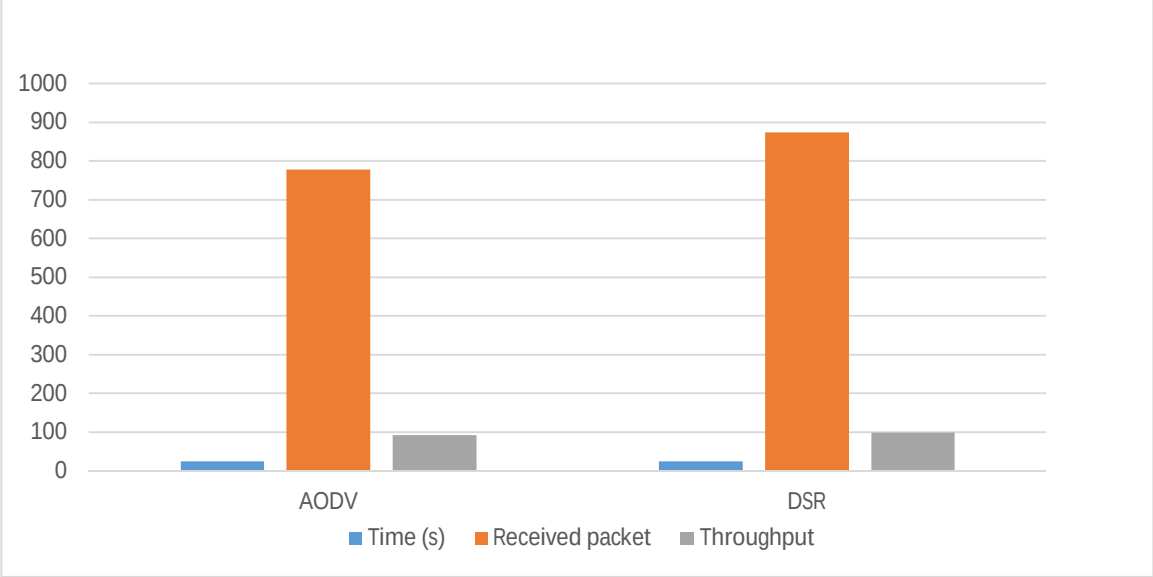


Figure 3. Average Throughput.

One definition of the PDR is the fraction of sent data packets that reach their destination. Thus, it may also be described as, where is the amount of nodes actually delivered by the sender and is the amount of nodes received[18].

Table 3. Packet Delivery Ratio

Protocol	Sent	Received	Forward	PDR
AODV	806	779	1893	96.68
DSR	903	874	1990	96.78

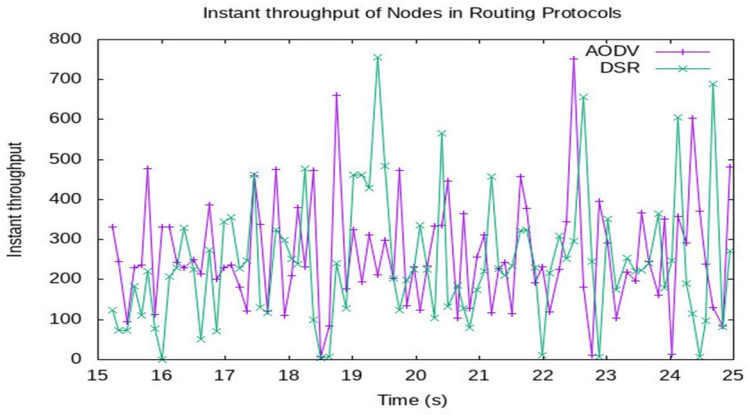


Figure 4. Instant Throughput of Nodes.

In this case, the value is indeed the throughput during a little time period, which is the mathematical limit of the throughput as time tends toward zero. Instantaneous throughput is synonymous with this word. In figure 4 shows instant throughput for protocol AODV and DSR in which both routing protocol have similar results but in some case DSR perform well[13].

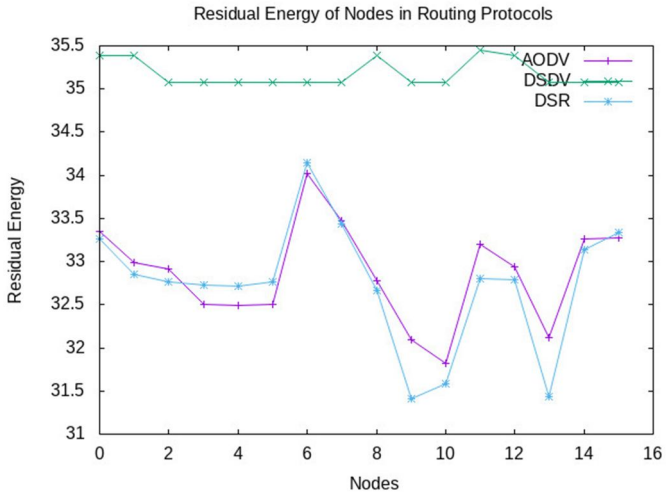


Figure 5. Residual Energy of Nodes.

The sensor node's remaining energy can be determined by adding up the energy it lost in each state. In addition to the classical thermodynamic approach, a finite state machine-based energy model with four states is employed here. In this case DSDV takes higher energy, DSR has lower energy consumption in comparison of AODV and DSDV.

V. CONCLUSION

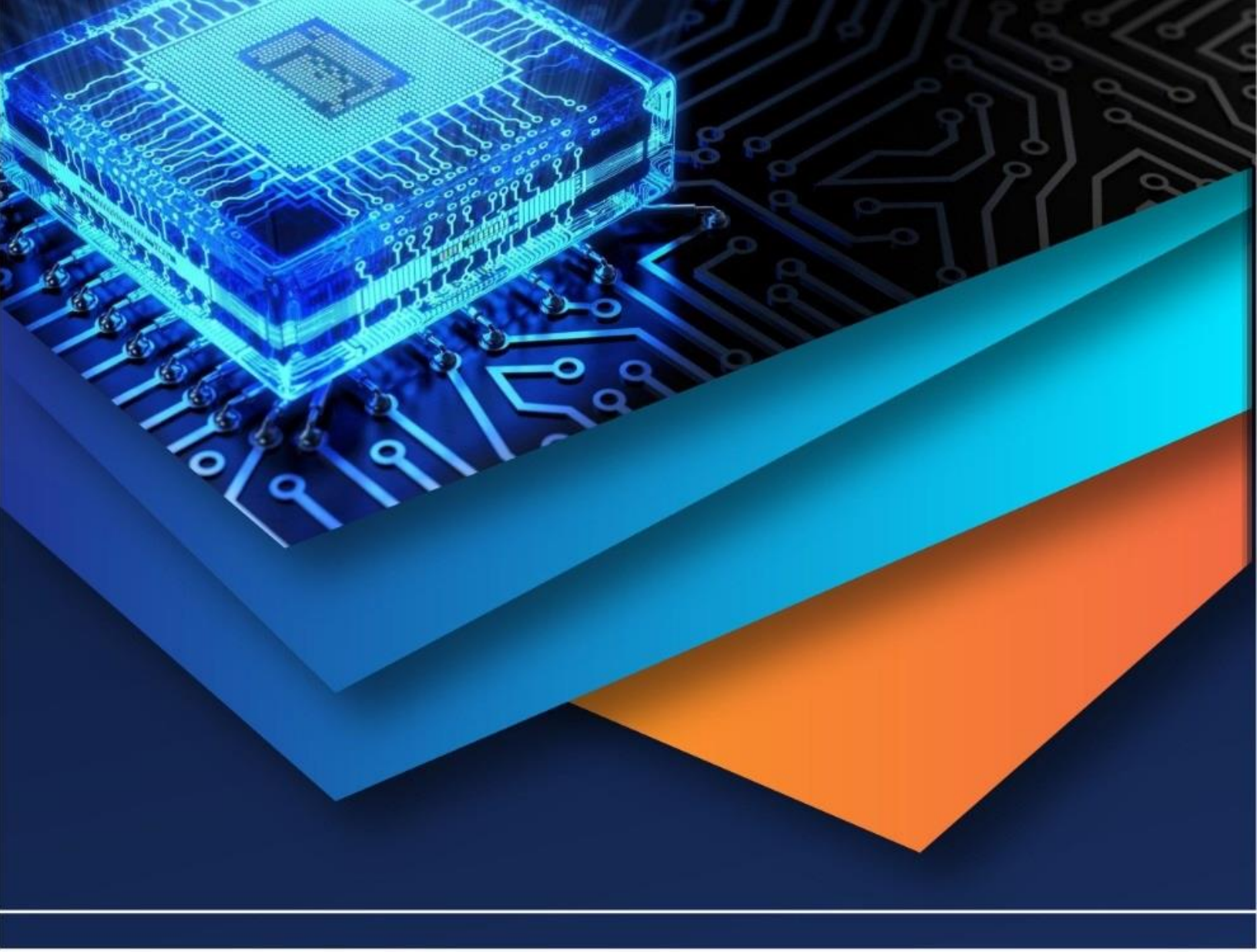
In this piece of research, there is a comparison made between the characteristics and overall performance of on-demand routing algorithms (DSR or AODV) as well as table-driven routing protocols (DSDV). Performance metrics include the percentage of delivered packets, the average end-to-end delay, the number of dropped packets, the forwarding overhead, the node mobility, and the increasing number of nodes. In a nutshell, the DSR protocol is superior to the other two when compared to its performance in typical scenarios. On the other hand, AODV performs significantly better under more tense circumstances. Since of this, using DSR is preferable to other methods because it achieves the best results when tested in conditions that are analogous to those that may be encountered in real life.

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