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Implementation of Hybrid Modified RED Algorithm for Congestion Avoidance in MANETS

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***Abstract**: Congestion detection and congestion avoidance is major issue in Mobile Ad-hoc Network(MANET). To avoid congestion various Active Queue Management(AQM) algorithms proposed. Among them Random Early Detection (RED) is the AQM algorithm where congestion avoidance can be achieved. A traditional RED algorithm suffers from high packet loss and lower throughput. Modified RED (MDRED) is an algorithm where dynamic threshold adjustment policy is used. In order to reduce the number of packet drops, Modified Gaussian Function-RED(MGF-RED) uses the Modified Gaussian function drop probability. A simple modification to RED algorithm called Hybrid Modified RED (HMDRED) proposed in the account of auto tuning the RED threshold parameters and packet dropping probability there by achieving lower packet loss and higher throughput. Proposed method also uses Modified Gaussian function (MGF) drop probability so that packets drop can be reduced. The HMDRED is simulated using network simulator and its performance is compared with existing RED algorithms. The results analysis shows that the HMDRED performs better than the other algorithms with respect to throughput, packet drop and packet delivery ratio*

***Keywords**: MANET, AQM, RED, MDRED, MGF-RED.*

I. INTRODUCTION

A mobile Ad-Hoc network (MANET) is a self-configuring network of wireless links connecting mobile nodes. These nodes may be routers and/or hosts. The MANET have no fixed infrastructure because mobile nodes convey directly with each other, without utilizing the access points. The routers are free to move in any direction when required and arrange themselves whenever they required. Thus topology will be dynamic. Every node or mobile device is comprises of a recipient and transmitter. MANETs are stated as autonomous, dynamic and purpose-specific. When the resource demands exceeds the capacity and packets are dropped due to very high queuing in the network then that state of network is called as congestion. Since there is no fixed infrastructure for MANET, there is no separate networking elements such as router, so nodes itself act as router, i.e. they are accountable for routing the packets. Thus congestion avoidance is very much important in MANET. A well- known technique for Congestion Avoidance in MANETS is Active Queue Management(AQM). The main goal of AQM is to respond to the initial congestion before the buffer space overflows. AQM allows responsive flows, such as TCP flows, react timely and reduce their sending rates in order to prevent congestion and severe packet losses. AQM algorithms run on the routers. They provide early feedback about the congestion to the source by monitoring instantaneous or average queue length. AQM algorithms checks whether average queue length is higher than a certain threshold and also checks that whether it is still less than actual queue length. If it is these algorithms ascertain the congestion and informs the end system to back off by dropping some of the packets at the router.

A. Existing Models

Prevention of congestion in the network is achieved through the active queue management (AQM) so that quality of service can be improved. So many AQM algorithms were proposed and implemented in the routers to avoid congestion. It means that by dropping or marking packets the router will try to decrease the sending rate of the traffic sources. The congestion can be avoided by two ways: Packets can be dropped and packets can be marked. Example algorithms are RED, DSRED, VRED, NLRED, ARDTA etc.

B. Hybrid Modified RED (HMDRED)

HMDRED is proposed algorithm which is the combination of MGF-RED and MDRED. In HMDRED the dropping probability of RED is replaced by the modified Gaussian function dropping probability so that packet drops can be reduced. RED uses the fixed threshold values so full queue utilization is not possible. To achieve the full queue utilization HMDRED implements the dynamic threshold adjustment of MDRED

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C. PAPER OUTLINE

The rest of this paper is organized as follows: Section II reviews the related work that has been carried out. Section III describes, Hybrid Modified RED algorithm which is a combination of MGF-RED and MDRED algorithms. Section IV gives the implementation of Hybrid Modified RED algorithm.

II. RELATED WORK

Variety of AQM algorithms were proposed and implemented in the routers to prevent the congestion. the papers related to dynamic threshold, dynamic weight parameter are discussed.

Sally Floyd and Van Jacobson [1] presented a mechanism called Random Early Detection (RED) in 1993 that aims at congestion avoidance. Among the so many AQM algorithms developed, RED is the first AQM algorithms ever developed. RED is suggested by IETF. RED is generally used with Transmission control protocol. RED has been used as premise for many other AQM algorithms that are to be discussed later in this chapter. By computing the average queue size at the router the algorithm detects inchoate congestion. The router drops or marks each incoming packet with a certain probability pa, Whenever the average queue size exceeds a certain preset threshold. By dropping packets which are incoming at the router, or by initializing a bit in packet headers (which is referred to as "marking a packet") connections are promulgated about the congestion.

Bing Zeng, mohammad atiquzzaman [2] proposed new active queue management scheme called "Double Slope RED(DSRED)". DSRED performs better than RED. DSRED identical to RED in two aspects. Firstly, it uses linear drop function similar to RED. Secondly, it uses the same definition to calculate the average queue length. Therefore DSRED inherits advantages RED. The idea behind this method is buffer segment is divided between kl and kh which are separated by meansof km where kl is minimum threshold and kh is maximum threshold and km is mid point between kl and kh.

Kaiyu Zhou, Kwan L. Yeung, Victor O.K. Li [3] proposed enhancement to RED called "Nonlinear RED(NLRED)". NLRED uses a nonlinear quadratic function in contrast to RED. In all aspects NLRED similar to RED except in the function used to calculate the packet drop probability. The main advantage of NLRED depends on nonlinear packet dropping function. In NLRED packet dropping is less for lower load and it is high for heavy load on the network. This is because NLRED uses the nonlinear quadratic function to drop the packets. When average queue size avg exceeds the minimum threshold, NLRED uses the nonlinear quadratic function to drop packets.

Sarita Simaiya, Anurag Shrivastava have proposed [4] "Improve RED(IRED)",a new approach to overcome problem of congestion for Mobile Ad- Hoc network by using improvement in existing RED. It is similar to RED but only enhancement made to RED is, instead of having constant thresholds it is using the dynamic thresholds.

A. Akintola, G. A. Aderounmu, proposed [5] "Dynamic Random Early Detection (DRED)" model. In DRED model a new parameter called warning line is introduced. In the DRED model, in order to notify the initial congestion stage earlier, the performance enhancements to the original RED model are introduced. Therefore enlargement of *wq* is carried out to increase the responsiveness of RED to bursty traffic. There are two enhancements to improve the scalability of the RED algorithm. The dynamic adjustment of the value of *wq* with the change of actual queue length over average queue length is the first improvisation in DRED model.

Shahram Jamali, Bita Alipasandi, Neda Alipasandi proposed [6] another measure i.e. queue length velocity is used to measure the congestion level in network. The RED algorithm uses only the average queue length as a congestion meter to trigger packet dropping or packet marking as a congestion feedback. In the RED the average queue length scrutinizes only long–term behavior of any queue, this approach fails to see instant changes of the queue length and hence its reaction is slower. This paper offers a new approach to measure congestion level in router. VRED uses the queue length growth velocity to measure the congestion level in router, and calculates the drop probability according to this meter.

III. HYBRID MODIFIED RED ALGORITHM(HMDRED)

HMDRED algorithm is the combination of MGF-RED [7] and MDRED [8] algorithms. In order to utilize the queue fully HMDRED uses the dynamic threshold adjustment policy. In order to reduce the number of packet drops it uses the Modified Gaussian function drop probability of MGF-RED to calculate the packet dropping probability.

A. Modified Red(Mdred)

This mechanism is based on dividing the queue between minimum threshold (min_{th}) and maximum threshold (max_{th}) into smaller subparts called *S1, S2, S3, S4, S5* and calculation of packet drop probability will be based on the position of average queue size

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(*avg*) in smaller subparts. It calculates the average queue size using the original RED formula. But it incorporates the auto-tuning of the queue threshold thus by enhancing the utilization of queue.

B. Mgf-Red

MGF-RED is the algorithm used in this project. In this algorithm packet dropping probability of RED is replaced with Modified Gaussian function drop probability so that reduction in the number of packets drops can be achieved. The packet dropping probability formula given by equation 1 given below,

$$P=a*v_a-x+d \qquad (1)$$

Where x= (avg_len-b) 2/2c2
avg_len is the average queue size and is given by:
avg_len= q_len*w and w is the queue weight and is constant value provided at the time of simulation.
Where P is new packet drop probability
v_a and v_b are constant and are given by
$v_a=1/max_{th}-min_{th}$
$v_b=min_{th}/max_{th}-min_{th}$
a=cos2 (theta) + sin2 (theta)
b=-sin (2*theta) + sin (2*theta)
c=sin2 (theta) + cos2 (theta)
theta= v_a*avg_len+v_b.

C. Hybrid Modified Red

The steps involved in the HMDRED is given below,
Step 1: whenever packet arrives at the router calculate the average queue length
Step 2: if average queue length< minimum threshold then Enque the packet
Step 3: if average queue length is > minimum thresholds and <= Maximum threshold then divide the threshold between minimum threshold and maximum threshold as *S1,S2 ,S3,S4,S5* and calculate MGF drop probability based on threshold values.
Step 4: if average queue length> maximum threshold then check whether maximum threshold is less than queue length if it is, increase the maximum threshold by the packet size and drop the packets with the probability *max_p*. If maximum threshold is not less than queue size then drop all the packets.
Step 5: Exit

V. IMPLEMENTATION of HYBRID MODIFIED RED ALGORITHM for CONGESTON AVOIDANCE

Implementation includes all those activities that take place to convert from the old system to the new. The new system may be totally new, replacing an existing system or it may be major modification to the system currently put into use Here RED algorithm is used as a base algorithm. Some modification applied so that we can achieve the maximum utilization of queue and we can reduce the packet drops.

A. Implementation Details

Here language used is OTcl for front end and C++ for back end. Platform used is FEDORA 11 and the simulator used is Network Simulator 2.34. Hybrid Modified RED architecture shown in Fig 1 gives the overall working of Hybrid Modified RED (HMDRED) algorithm. Source node is the node from which the packets are being sent, intermediate nodes acts as routers to forward the packet to the destination node.
AQM policy is being employed in the intermediate node. After the arrival of each packet at the router the average queue length is calculated. The calculated average queue length is then compared with the threshold values and threshold values adjusted.
Also the packet dropping probability is also adjusted. Hybrid Modified RED algorithm uses the MGF drop probability and also uses the MDRED to calculate the threshold values.

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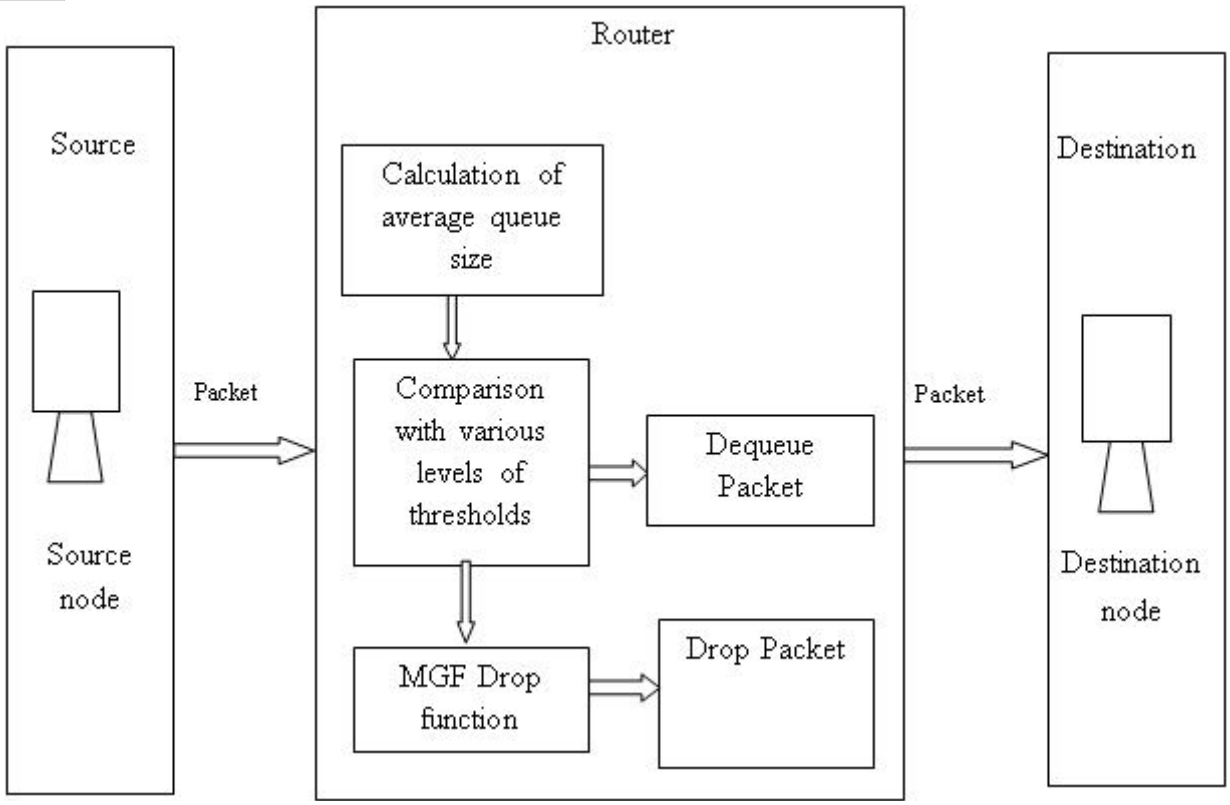


Fig.1 Hybrid Modified RED Architecture

A. Simulation Scenario

Initially the procedure calculates the throughput, Packet Delivery Ratio and Packet Drop for RED algorithm. Then the same procedure is repeated for the Modified RED and Hybrid Modified RED i.e. the proposed algorithm. he simulation results shows that the proposed algorithm give the better network performance in terms of throughput, Packet Delivery Ratio and Packet Drop. In the simulation comparison of existing algorithm with the proposed algorithm has been done. The simulation parameters are shown in table 1.

Table 1 Simulation Parameters

Parameter	Value
Routing Protocol	AODV
Number of Nodes	30
Area	1128 m*100 m
Packet Size	500b
Simulation Time	30s
Traffic Pattern	CBR

Some of the important parameters defined in Hybrid Modified RED algorithm along with their initial values are as shown below

Minimum Threshold = 7500 bytes
Maximum Threshold = 22500 bytes
Queue Size = 30000 byte
Mean packet size = 500 bytes
Queue weight= 0.002
Queue in bytes = True

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B. Results And Discussions

The results have been obtained by using the NS- 2.34 simulator and results shows that our proposed algorithm performs better than traditional RED and Modified RED algorithm in terms of throughput, packet delivery ratio and packet drop rate.

1) *Throughput:* It may be defined as the total amount of data received by destination from the source node divided by time taken to receive the last packet. Fig 2 shows the Simulation Time (X- Axis) versus Throughput (Y -Axis) of HYBRID Modified RED, MDRED and RED. It has been clear from the figure that the proposed algorithm (HYBRID Modified RED) gives the higher throughput than the Traditional RED. The simulation is carried out for 30sec.

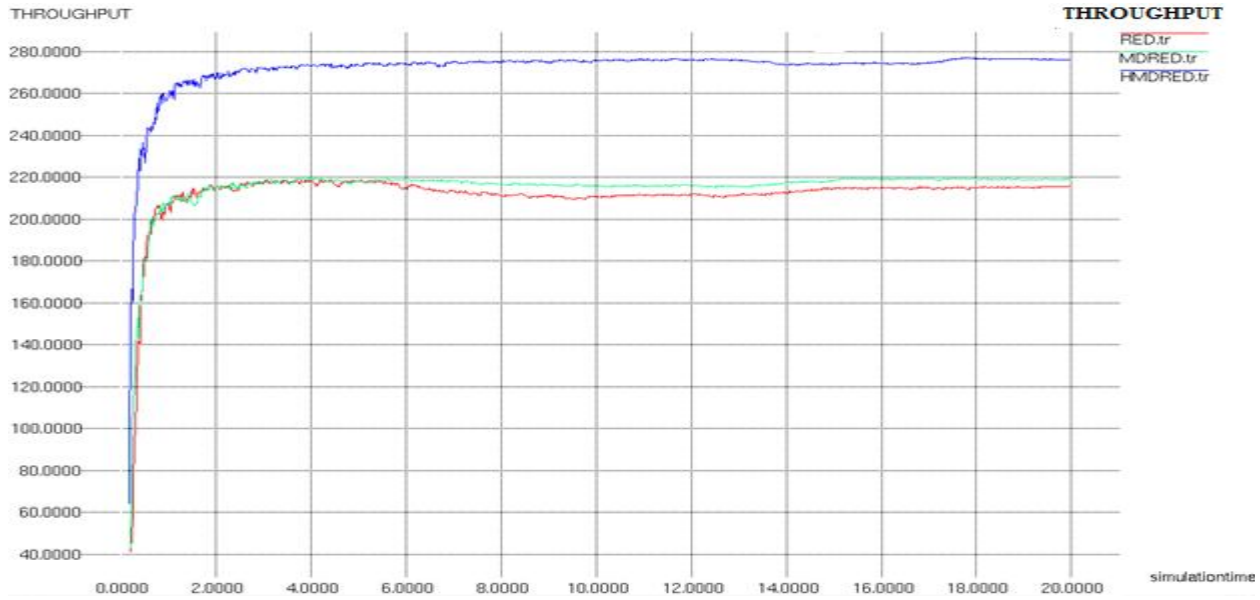


Fig. 2 Throughput

2) *Packet Delivery Ratio* :It is the total number of packets received by destination to total number of packet sent by source. Fig 3 shows the simulation time (X- Axis) versus packet delivery ratio (Y -Axis) of HYBRID Modified RED, MDRED and RED. When average queue size crosses the minimum threshold there is a drop in packet delivery ratio in and when it approaches the maximum threshold there is increase in packet delivery ratio and when average queue size crosses the maximum threshold PDR stabilizes. Above graph depicts that PDR of HMDRED is more than that of MDRED and RED

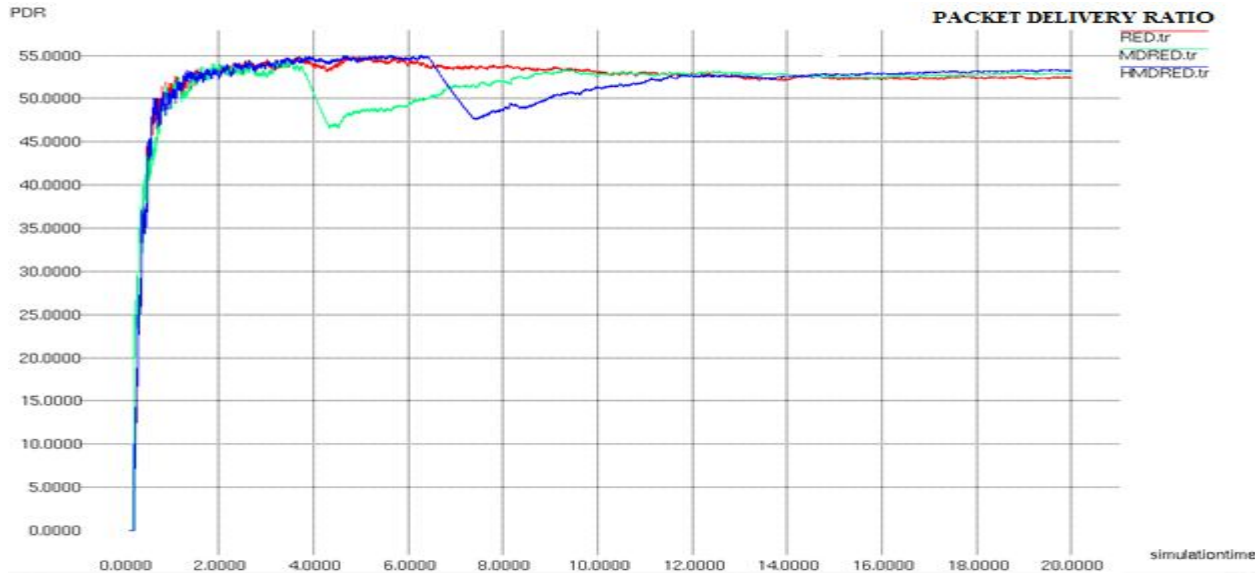


Fig. 3 Packet delivery ratios

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3) *Packet Drop :* It may be defined as the total number of sent and forwarded packets minus the received packets. Fig 4 shows the packet drop comparison of RED, Hybrid Modified RED and MGF - RED. Here X - axis shows the simulation time and the Y - axis shows the Packet drop. Number of packet dropped is less for HMDRED and MDRED when compared with RED. The reason is MDRED and proposed HMDRED algorithm employs the dynamic threshold policy results in full queue utilization. But when we compare MDRED and HMDRED, the packet drops for HMDRED is very less than MDRED, since the linear dropping probability of MDRED is replaced with Modified Gaussian function in HMDRED.

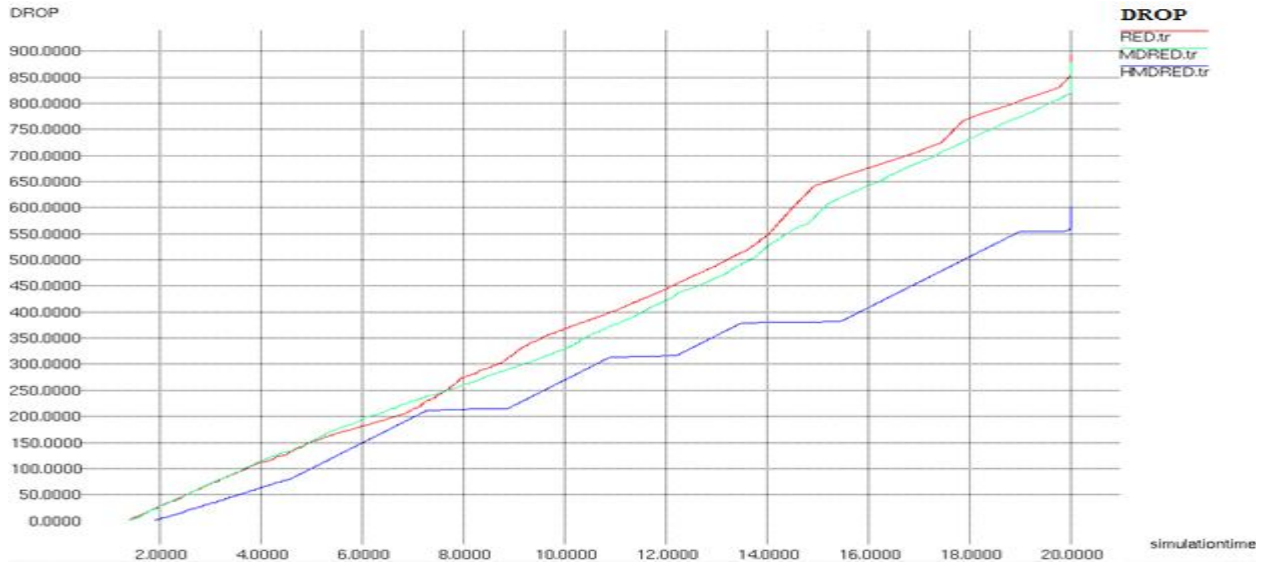


Fig. 4 Packet Drop

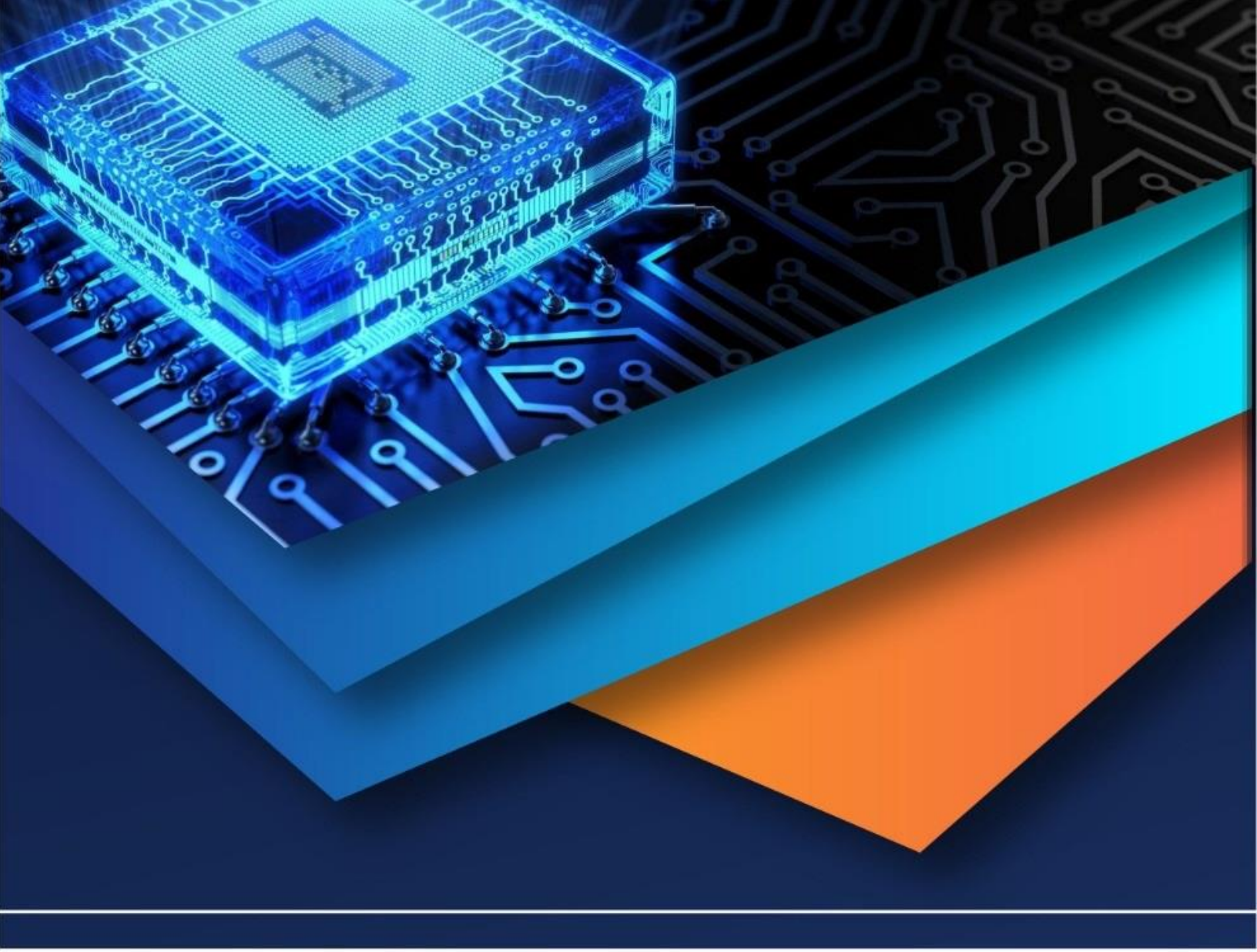
VI. CONCLUSION

Traditional RED suffers from high packet loss and lower packet delivery ratio and lower throughput. To overcome these disadvantages HMDRED has been implemented. HMDRED makes use of dynamic adjustment policy according to the current traffic conditions. A dynamic adjustment policy is designed to regulate the maximum packet dropping probability and threshold parameters using average queue length. HMDRED also uses the Modified Gaussian function drop probability which results in reduction in the number of packet drops. The proposed algorithm was compared with RED and MDRED by using NS-2 simulations. The experimental results demonstrated that HMDRED outperforms RED, MDRED and in terms of network throughput, packet delivery ratio and packet drops. Also HMDRED does the high utilization of queue space and it is more resilient to dynamic workloads compared to RED algorithm.

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