International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-7, Issue-6S3, April 2019

An Energy Efficient Dynamic Probabilistic Routing Algorithm for Mobile Adhoc Network

Haripriya Nair, P.Manimegalai, N.Rajalakshmi

Abstract: ***In Mobile Adhoc Network (MANET) flooding is used as the broadcasting mechanism for identifying the network path between sender and receiver nodes. The implementation of flooding mechanism reduces the performance of the whole network. This traditional flooding mechanism generates the large number of duplicate packets which were transferred all along the network which increases the network contention, collision and retransmission. A probabilistic broadcasting algorithm is used to optimise the flooding mechanism to avoid the broadcast storm problem in MANETs. The dynamic probabilistic routing algorithm is developed to handle packet duplication and error generated due to noise present in the wireless channel. The retransmission probability value is calculated by considering the number of nodes in the neighbourhood MANET environment [1]. This algorithm is tested and compared with the traditional routing algorithm in terms of significant parameters like packet delivery ratio, end to end delay etc…***

Index terms: MANET, Flooding, Contention, Collision, Probabilistic Broadcasting

I. INTRODUCTION

Mobile Ad-hoc Networks (MANETs)[1] isgenerated by framing mobile nodes together to form a temporary ad-hoc network. The MANET doesnot require any infrastructures.

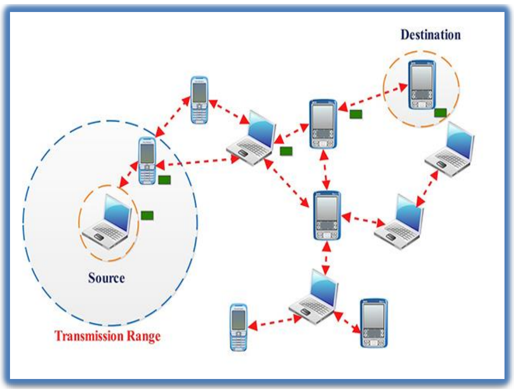
The MANETs do not have any centralised structure such as the router to discover new nodes and to communicate between nodes in the network.

The MANET nodes are omnipresent, powered by battery source and mobile in nature. The nodes in a network communicate and arrange themselves accordingly either as a separate network or as a part of a large network such as the internet. Figure 1 shows the typical MANET. The mobile devices in network arrange themselves in coordination to establish communication. MANETs form with IEEE 802.11 Wi-fi protocol which can provide an Ad-hoc networking [2] facility. The types of MANET include

Revised Manuscript Received on December 22, 2018.
P.Manimegalai : Professor, Department of Electronics And Communication Engineering, Karpagam Academy of Higher Education, Coimbatore
N.Rajalakshmi: Associate Professor, Department of Biomedical Engineering, Karpagam Academy of Higher Education, Coimbatore
Haripriya Nair: Research Scholar, Department of Computer Science And Engineering, Karpagam Academy of Higher Education, Coimbatore

The numbers of routers between two specific nodes may increase or decrease depending on the nodes mobility in the

Figure. 1. Typical Mobile Ad-hoc Network



- **iMANET[3](Internet Based Mobile Ad-hoc Networks):**
  A link is created between the set of mobile nodes and the gateway nodes connecting to the internet. In those types of networks it is observed that given network general ad-hoc routing algorithms do not directly involve.

- **FANETs (Flying Ad-hoc Networks):** FANETs are the most important category of mobile ad-hoc networks. FANET develop a set of Unmanned
- Aerial Vehicles (UAV) which will create a type of ad-hoc network architecture.
- **VANETs (Vehicular Ad-hoc Networks):** In a VANET vehicles are treated as nodes that constitute the network. Every vehicle is considered as a node or wireless router, facilitating the connectivity between the vehicles within a range of 100 to 300 meters forming a network with a wide range.
- **Smart Phone Ad-hoc Network:** In order to reduce the dependency on cellular networks, smart phones use MANET technology to form a flexible structure which is decentralized in nature.

*Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication*

The merits of MANET is that the network is decentralised and nodes are mobile because the infrastructure is not fixed and has the capability for enormous applications like environmental monitoring, disaster relief and military communications. The MANET has high mobility and can enhance the capacity of the network. MANETs are stronger than the centralised networks due to multihop fashion. A single failure in MANET is reduced considerably because the data take a multipath transmission. MANET can eliminate issues like isolation/disconnection from the network. The networks of MANET have a fixed topology including flexibility.

Further advantages include scalability and low cost of administration. Due to the above-mentioned advantages, MANETs apply in military, private and government firms. Furthermore, vehicles with built in mobile devices use MANETs to retrieve information regarding weather, traffic and journey time. MANETs have benefits such as dynamic topology where the nodes in the network are free to move anywhere randomly making the network topology and routing change at a rapid pace.

The disadvantages of MANETs is that the data transmission's bandwidth is not restricted by the user but set by mobile devices. The rate of data transmission and node operation is limited through the battery energy source. The battery powered mobile nodes are small in size which makes them prone to physical abuse than fixed cable networks. These mobile devices can be easily hacked, cloned and can be physically attacked easily.

The performance of the network varies because the network is decentralised. Due to interference in network topology and connectivity, the mobility of devices will affect the performance of the network and thus resulting in resending of data for some times. The power allocation for resources of the network is unclear. Energy management in MANETs is not fully attainable. Since the medium for communication in MANETs is shared, they are easily prone to attacks than the wired networks, and there is no central coordination in MANETs. Since the network's topology is changing constantly, problems occur while routing packets among any pair of nodes.

The wireless transmission range is limited due to the wireless medium's broadcasting nature.

A.Literature Survey:

The mobile ad hoc networks (MANET) solves the problem, by using the Dynamic Source Routing [4] (DSR) based mechanism. The CBDS combines the merits of reactive and proactive defence mechanisms and provides an efficient mechanism to detect malicious nodes. Initially it adopts a reactive approach and then shifts to proactive mode when a suspicious activity like dropping of too many packets occur. The CBDS techniques makes use of a reverse tracking method to detect the malicious node though a bait. The malevolent nodes, require to lead the security concerns; for example, nodes may interrupt the routing process.[5]

MANETs [1] provide a standardised framework for the network layer protocols. MANETs employ a TCP protocol at the transport layer. The TCP which offers data transmission with high reliability, is used so that the integration with wired network is possible. Transmission control protocol is a transport protocol in the wired internet, it integrates with different network conditions. The TCP-Vegas could not be used to the MANETs, because of the route change RC could be made the Base RTT applied over a premature path obsolete. [6]

MANET routing mechanism is a vital & routing decision, it should be made sooner previously the nodes leaves the network. Quick decisions always compensate with the network performance. The Mobile Ad Hoc Networks routing protocols accept a cooperative environment, &are vulnerable to different attacks. Reputation and Trust would serve as a main solution to these issues. Learning the routing decisions and network characteristics at right times will be the substantial solution. [7]

Buffer management system is presented to manage the packet queues in a MANETs for mobile nodes. This system implements to attain an effective queuing within the buffer of a MANET node. An active queue management is used by communicating MANET node through the dynamic buffer space. The neighbouring nodes are proportion to the packet queues arrived from the neighbours & then controlling the packet drop probabilities. [8]

For MANETs, ant-based routing protocols has been explored. However, the maximum the single-path routing techniques are the lowest path from the source into destination. Node-disjoint occur in several path during routing and swarm intelligence implement to alleviate these issues. This method is called as "Ant energy – aware and disjoint multipath routing algorithm (AEADMRA)[9] ". This algorithm adopts the concept of swarm intelligence [9] and is designed to be used as a Meta heuristic routing method. This algorithm is capable of finding out multiple energy aware routes without increasing the overhead costs [10]

In MANETs [1] the lifespan of network is predicted with Unscented Kalman Filter. The Unscented Kalman Filter evaluate at different states, as a nonlinear scheme, by using the distances between nodes as inputs. Unscented Kalman Filter are used to calculate the remaining lifetime of network. These algorithm establishes the robust performance; it calculates the Mobile Ad Hoc Networks link lifetime for the different mobility model [12].

The Mobile Ad Hoc Networks present an overall perspective of delay analysis and multicast capacity. Particularly, considering the following four architectures for node mobility: 1) 2D mobility, 2) 2D arbitrary walk, 3) 1D mobility, 4)1D arbitrary walk. The mobility is measured in the time-scales

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

period. i) High speed mobility when the movement of node is dependent on the time scale transmissions. ii) Low speed mobility when the node movement is accepted to happen at alow speed time-scale transmission. Delay constraint D, the initial functions the multicast capacity for every nodes having the eight different kinds of mobility architectures. Then this system attains significant capacity-delay. [13]

The problems in mobile adhoc network such as increased overhead, lengthier routing paths and higher path stretch ratio were avoided by analysing the relationship between the logical identifier structure (LIS) and physical network (PN) through routing protocols using distributed hash table (DHT). A 3-dimensional logical identifier space is involved to solve the mismatch problem were individual nodes perform consecutive logical identifier (LID) for routing the packets in the network. Multi path and multi hop communication was established through the 3-D logical identifier structure. [8]

The Distributed hash table (DHT) have useful addition to the specification and design of spontaneous, and self- organising networks. The two major problems that considered while design the DHT based protocol, are logical network resilience and mismatch issues, it degrades the effective Distributed hash table based protocols. Distributed hash table based protocol exploits a 3-dimensional structure to disrupt node relationship. This advanced system, every node follow a distributed algorithm to calculate a logical identifier that change the 3 D logical space. Anywhere the protocol uses the 3-dimensional structure to preserve the several paths into the destination nodes. [14]

Improvements in the communication devices provides mobility for the users which increases the applications of MANETs. Maintaining power is the important issue faced in the MANET. An efficient power-aware routing protocol (EPAR) is developed to increase the network lifetime in MANET. Different from the conventional power aware methods the EPAR protocol considers the capacity of the node by calculating the expected power consumed for forwarding data packets. It predicts the energy consumption instead of handling the residual energy of the network. Through min-max calculation, the EPAR protocols identify the route with maximum data handling capacity along with the lesser power consumption. [15]

The functioning of the mobile ad-hoc network depends on the cooperation of self-interested relay nodes. Hence maintaining the cooperation level is very crucial. The packet loss in the cooperative packet transmission through single hop unreliable channels due to noise is observed. Based on the evolutionary game theory an indirect reciprocity framework is developed for both structured and unstructured MANETS. The dynamics of the cooperation method is measured by setting a threshold for benefit to cost ratio. This ensures the cooperation convergence. [16]

Enormous traffic needs for omnipresent access and growing multimedia applications considerably increase the battery-powered mobile device's energy consumption. Thus energy efficiency is an important criteria in MANETs. In cross-layer design based MANETs optimisation of energy efficiency is measured in bits per joule. This energy efficiency optimisation problem is designed as a non-convex mixed integer nonlinear programming (MINLP) approach including scheduling of traffic, routing and power control. The optimisation problem is still difficult to solve because the MINLP approach is NP-hard. So a modified branch and bound algorithm (BB) is introduced to resolve this optimisation problem. This algorithm has lower and upper bounding schemes, and branching rule is modelled using the non-convex MINLP properties. [17]

In MANETs the decentralized method adopted for file sharing is generally classified into three categories based on advertisement, social contact and flooding. The flooding and advertisement based P2P sharing methods has overhead more and scalability less. Especially these file sharing methods are developed for MANETs with connected nodes where the end-to-end connectivity is assured. The social contact-based P2P sharing methods adjusts to the opportunistic behaviour of MANETs with disconnected nodes but not considering the mobile node's social interests that can be utilised to access the files more efficiently. To address these issues, MANETs that are not fully connected use a decentralized file sharing system based on the file content. In this technique, the system employs an interest extraction algorithm which extracts the node’s interest by analysing the contents of the file.

Named data networking (NDN) gives a solution to the internet connectivity problems using the TCP/IP. In MANETs with NDN-based, the nodes in the network operates in conditions such as fluctuations in the network channel, low battery power, no proper connectivity and so on. Due to the wireless channel’s distributive nature, the performance of the network is degraded. To address these issues, a new location-aware on-demand multipath caching and forwarding (LOMCF) protocol is presented for MANETs based on NDN. [19]

A distributed dynamic address configuration technique based on a low-overhead identity is presented to set IP addresses securely to the nodes of a managed MANET. Through a present node, a new node will get an IP address. Soon after every node in a network can create an unique IP addresses set from its original IP address and can be assigned to new nodes. These type of networks has network partitioning and network merging and high packet error rate. To address these issues, the advanced protocol does not need any flooding strategy over the total MANET. [20]

The perfect throughput capacity of a node in a MANET is analysed where each node's transmission power can be regularised to adjust to a particular transmission range. A 2 hop relay in which the repetition of packets are limited to f is used for routing. From the Markov chain model and the automatic feed control concept, a generalized mathematical model is developed which fully describes the packet delivery approach in the MANET. [21]

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

The statistical models for accurate evaluation of the wireless links lifetime distribution in a MANET is presented where the nodes are moving randomly within limited areas. The computation of the lifetime of the link is through a two-state Markov model and the statistics computed are applied to a message stream's segmentation scheme optimisation. [22]

In autonomous MANETs, each users has its control, and there is cooperative enforcement issue. This

cooperative enforcement issue should be solved for enabling networking operations like packet forwarding which is very critical in presence of interferences and faulty monitoring. The cooperative enforcement in autonomous MANETs is taken into account in presence of interferences and faulty monitoring. Basically the forwarding of packets between users are done with the help of iterative game models with faulty observation. The cooperative – enforcement packet forwarding approaches can be performed by a belief evaluation framework that is derived from the information contained privately in each node and the faulty observations of another node. [23]

A MANET with limits such as lifetime of packets and size of the power and the consequences of such limits impacts performance of the network issue is addressed. The network's perfect throughput capacity is analysed first to expose the network's utmost attainable throughput performance not depending on the input rate. A full theoretical framework is formulated using the Markov chain theory, and this framework gives attainable throughput independent of input-rate and packet loss ratio is to be computed in closed form in presence of any exogenous rate. Using the *M /G/1 / K* queuing theory, in presence of any exogenous rate, the end-to-end packet delay is analysed to show how the lifetime of packet and size of the buffer affect the network's packet loss ratio, packet delay and throughput. [24]

The major problem in routing in MANETs is the selection of dependable paths which can occur long last as possible because the terminal mobility induce the radio links to break frequently. To resolve this issue, a standard that can estimate path reliability is required. The path reliability depends on the links count and the each link's reliability forming the path. A prediction based estimation of link availability is introduced to measure the reliability of the link. This prediction based estimation uses certainly present information available and takes into account the dynamic behaviour of the status of the link to indicate the link availability. Furthermore, this prediction based estimation is used for developing routing metrics for selection of path including path reliability to enhance performances of routing. [25]

Wi-Fi ad hoc networks transmit information from source to destination thru multiple hops. The work [26] gives a framework for cooperative communication in which the nodes cooperate to disseminate each nodes information to every other node. This type of cooperative strategy helps in increasing efficiency of the network in terms of energy utilization, throughput and lifespan.

EBCR [27] manages the routing information with optimum utilization of resources. Furthermore, EBCR depends only on localized network information .With a standpoint to the up and coming age of wireless mobile technologies, EBCR gives an essential idea to incorporate the multiplicity of radio standard within a non-homogeneous network.

This work [28] takes into account the energy available within a node and also computes the energy that can possibly be extracted from the surroundings of the source node. The algorithm works to figure out the path with the shortest energy distance and it is chosen to be the final path for routing purpose. The [28] "Distributed Energy Harvesting Aware Routing Algorithm" is not a fully-fledged routing algorithm as it does not take into consideration other integrated factors while deciding the path and focuses solely on the ability of node to extract energy from the surroundings.

To achieve energy efficiency and better mobility among the nodes; concept of cooperative communication is added in wireless networks. Cooperation in wireless ad-hoc networks has emerged as effective strategy to achieve better energy efficiency and reliability. This strategy allows a number of intermediate nodes to cooperate with each other during data transmission. This method of cooperative routing will help in reducing the amount of energy consumed, and will also reduce the chances for errors at bit level. But it is not possible to take advantage of this strategy if only a single relay node is participating in the transmission at each hop [29].

Nowadays IoTconcepts are very popular, so Machine to Machine networksare attracting plenty of interest. But, the characteristic of supporting multiple hops will decreasethe overall performance because of dissemination of errors. Thus the use of cooperative communication can help to improve the transmission range and decrease the hop count.[30]Attempts an in depth study on this possibility.

II. METHODOLOGY:

MANET uses flooding mechanism to identify the location of the destination in the network. Due to the lack of centralised architecture, flooding mechanism plays important role in tracking the location of the mobile node. The movement of nodes in MANETs is not well suited for implementation of traditional routing algorithms like AODV, DSR, and DSDV protocols. Flooding mechanism transmits the REQ message throughout the network to identify the destination node.

The packet was duplicated every time it reaches the next neighbour node. The duplicate packets will be discarded to avoid looping within the closed path. Even though the packets will be received as multiple copies to the same neighbour node from different intermediate nodes. This increases the consumption of power in transmitting the duplicate packets in the network. Moreover, the data packet is routed throughout the network which is not required.

To overcome the redundant problem in traditional flooding mechanism in MANET, the dynamic probabilistic routing algorithm is introduced. Receiving the same data packets repeatedly due to flooding action consumes more power and increases contention in the wireless medium. To overcome this effect, the dynamic probabilistic routing algorithm fixes the probability value p for the routed packets in the network. This probability value is used to eliminate the transmission of packets to the same neighbouring nodes repeatedly. This methodology provides an alternative approach to control the flooding packets in the MANET.

In the densely populated network, multiple nodes cover under same transmission range. This leads to transmitting the same packets to all the nodes present inside the coverage region of the transmitting node. Thus the generation of duplicate packets will be more. Hence, probabilistic control is utilised to limit the retransmission packets and reduce the consumption of energy without compromising on data rate. In smaller networks the probability of generation of duplicate packets is low, but in the larger network, the probability will be high which leads to congestion in the network. In the noisy environment, the effect of duplicate packet generation worsens the situation in MANET.

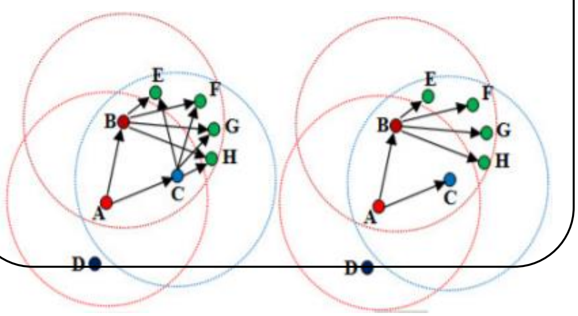


Figure 2: Routing packets in Flooding and dynamic probabilistic routing algorithm

The performance of flooding and probabilistic routing algorithm was represented in figure 2. The generation of duplicate packets is reduced based on the probabilistic value generated depending on the number of neighbour node present closer to routing node. The dynamic probabilistic routing algorithm is developed as follows.

Algorithm: Dynamic probabilistic flooding

Step 1: Receive the data packet at N_i.

Step 2: If packet received != duplicate packet
Then set probability p =1

Step 3: Check if NBR table_size == null

Then return(0)

Else then return NBR table size

End if

Step 4: Calculate Probability value, P.

$$P = \prod_{j=0}^{Snbr(j)} P * Pmax$$

Step 5: Compare if P < Pmin

Then P = Pmin

Step 6: return P value.

Step 7: if P > RN(i)
Then relay the packet to the next neighbour node.

Else then drop the packet.

From the above algorithm, the Ni represents the random node in the network considered for calculating the probability for relaying the packet. P represents the probability factor. Pmin refers to 1 which is initially set at the transmitting node. RN(i) refers to the random number generated by the node N(i). S_{nbr} represents the no of neighbour nodes for the Nth node in the given network.

The chance for retransmission according to dynamic probabilistic routing algorithm is controlled by the number of nodes in the neighbourhood. The probabilistic value P, measured is different in different locations in the network. The probabilistic value is higher in the thinner area with the lesser neighbour node, and the probabilistic value is low in the dense area were each node possess several numbers of neighbour nodes. This method limits the retransmission rate which saves the scarce resources of the MANET.

The performance of the DPRA is analysed using network simulator tool and also in the hardware environment. The hardware implementation of the network connected to the WiFi is shown in Fig. 3. A WLAN is developed to transfer data between the systems through a multiple-hop communication technique. The intermediate systems between the sender and destination systems act as a routing node which relays the data packet to the destination node. The flooding and dynamic probabilistic routing algorithm was implemented, the power consumption and time taken by the system were recorded to analyse the efficiency of the system. The hardware output is compared with the simulated output to identify the correlation between the two values.

Figure 3: Hardware implementation

III. RESULTS AND DISCUSSION

Here the dynamic probabilistic routing algorithm (DPRA) applies to overcome generation of duplicate packets during rebroadcasting in intermediate nodes. The simulation results are generated using Network Simulator2 (NS2). The transmission and network range assigned is 250m and network range is 1000mx1000m. The 80 mobile nodes are selected. The transmitted bandwidth rate is 2Mbps the source node requests the routing path and transmits packet rate of 10bps with the size of 512 bytes. This process is iterated and is terminated when all node route is identified.The proposed DPRA algorithm is tested and compared with the traditional routing algorithm. Table 1 represents the parameters assigned for simulating MANET in NS2 simulator.

Table1: Simulation Parameters

Simulation Parameter	Value
Network Range	1000mx1000m
Transmission Range	250m
Mobile Nodes	80
Traffic Generator	Constant Bit Rate (CBR)
Bandwidth	2 Mbps
Packet Size	512 Bytes
Packet Rate	10 bps
Simulation Time	60 seconds

The performance of the system is analyzed using the following metrics.

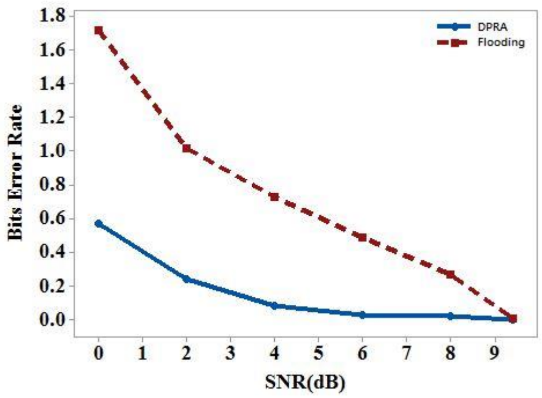


Figure 4: Bit Error Rate

Bit error rate (BER) is shown in figure 4. It is calculated by adjusting the SNR value in the network. When the SNR decreases the BER increases and vice versa. Thus an increase in SNR leads to a decrease in BER. The flooding protocol possess a higher bit error rate even the SNR value is low and decrease rapidly by increasing the SNR ratio. The DPRA protocol possess minimum bit error value of about 0.6 for 0 SNR and generates the lesser drop in bit error rate while increasing the SNR ratio.

Figure 5 shows the flow of end to end delay in the simulated network. The delay is calculated after varying number of hops in the network. When the number of hops increases by 10, the delay also increases proportionately. The hop counts proportionally increases the delay rate due to increase inprocessing of REQ message in the hop identification phase. The standard value for I hop is 2.50µs so DPRA protocol generates 3.75µs of delay for 10 hops between sender and receiver node.

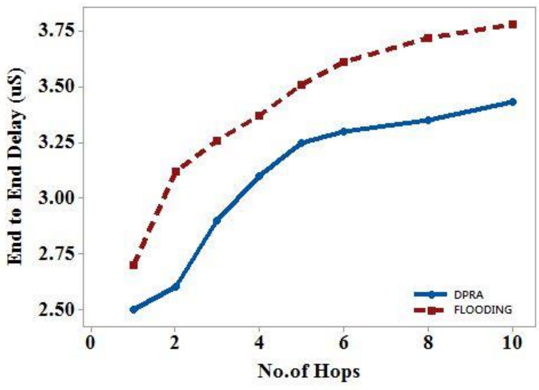


Figure 5: End-to-End Delay

Figure 6 represents the Jitter measured in the network. Jitter is the measure of variation in the delay generated during the transmission of the packet. Increase in jitter value increases the instability of delay in the network. The flooding protocol generates higher jitter value due to random broadcasting of the data throughout the network.

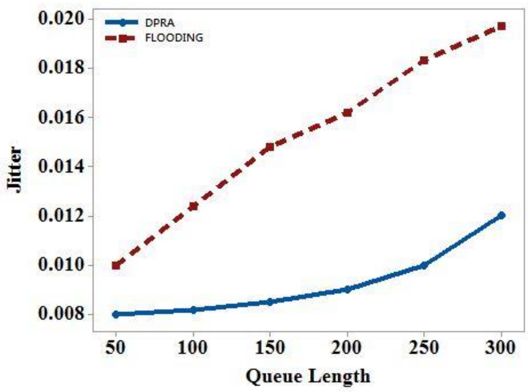


Figure 6: Jitter

The jitter increases rapidly due to flooding protocol, but DPRA protocol generates smaller jitter value which show it is more stable in generation of delay in the network. Overhead is the measure of generating routing packets to establish communication between the sender and receiver node. Figure 7 represents the normalized overhead plot for flooding and DPRA protocol.

Initially, the flooding protocol generates maximum overhead due to the property of rebroadcasting mechanism for identifying the route. The variation of overhead in the protocol was measured based on the size of queue length in each node, and the congestion rate was increased by generating multiple communications at an initial time interval. The DPRA protocol generates the overhead value of 1.2, and the overhead increases in both the protocol at the queue length of 250bits.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

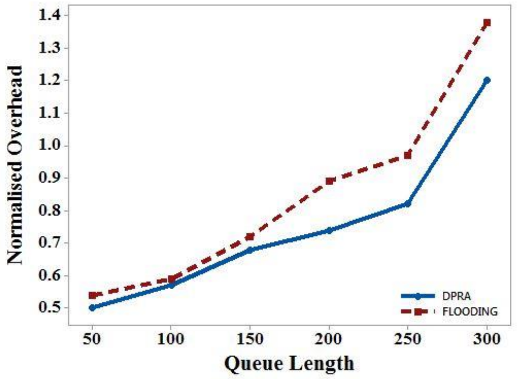


Figure 7: Normalized Overhead

Figure 8 shows the packet delivery ratio of the network. The DPRA protocol generates maximum delivery rate even at the initial state of the network. The packet delivery rate of the network is measured based on the simulated time. The DPRA protocol generates the maximum packet delivery ratio of about 87% for the simulated period of 20 seconds. Due to the process of rebroadcasting the flooding mechanism drops many packets which affect the packet delivery ratio of MANET.

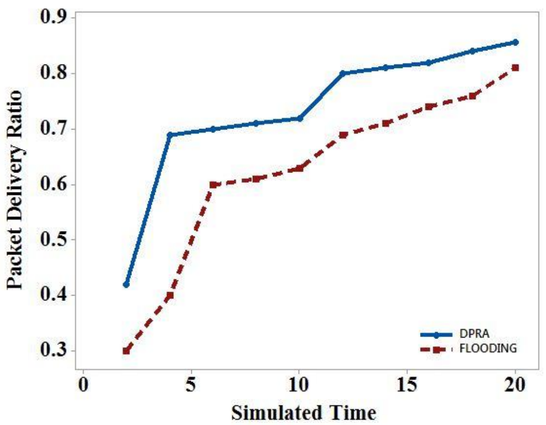


Figure 8: Packet Delivery Ratio

Any congestion that is generated in the network will lead to an increase in the packet drop rate hence leading to an increase in the number of retransmissions. Figure 9 shows the retransmission rate in the network. The SNR value is fixed as 6dB, and the number of hops is increased to measure the change in retransmission rate in MANETs. The flooding rebroadcast several packets to initialize the route itself, which drastically increase the retransmission rate, and the increase in congestion rate affects the flooding technique. The flooding technique reached the maximum retransmission rate above 4 at 10 hops, but the DPRA routing algorithm reaches the rate to 4 at 10^{th} hop in the network. Increase in retransmission increases the consumption of power in the network.

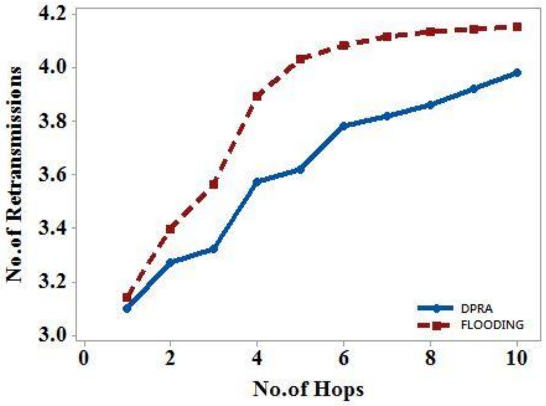


Figure 9: Retransmission Rate

Figure 10 shows the residual energy consumed by the network throughout the simulated time. The simulated time is fixed as 20 seconds. Flooding mechanism consumes more power than the DPRA algorithm. The power consumption by the network increases rapidly in flooding mechanism, and a maximum of 200mJ of power is consumed in a simulated time of 20 seconds. The power consumption in the DPRA algorithm is stable due to probabilistic approach in transmitting the packets and consumes only 101 mJ of energy during the time period of 20 seconds. The energy value remains almost constant beyond 20s..

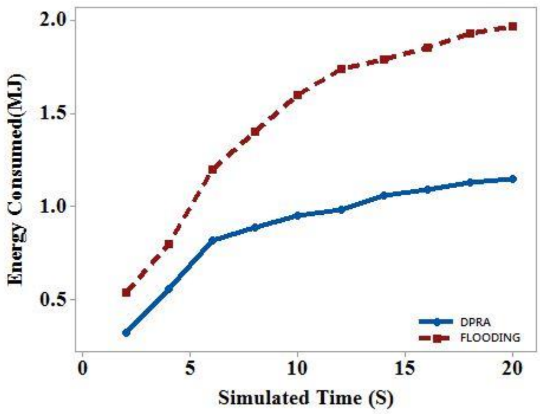


Figure 10: Residual Energy

Figure 11 shows the packet loss ratio, which is inverse to the PDR. It shows how the rate at which the packets are dropped is effected if there are more number of hops between the source and destination nodes. The delay and packet drop in the network decreases the performance of the network. The (Packet Delivery Ratio) PDR value increases steadily in DPRA algorithm, but in flooding the packet, drop increases rapidly as an increase in a number of hops. Retransmission rate increases in increase with a number of hops in flooding mechanism.

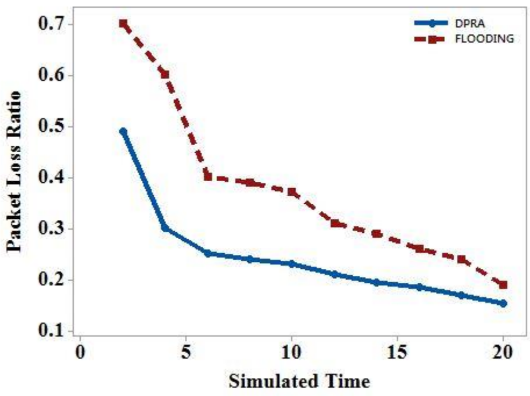


Figure 11: Packet Loss Ratio

Generation of duplicate packets increases with the increase in distance between the sender and receiver nodes in the flooding mechanism. The DPRA algorithm reduces the unwanted broadcasting hence, packet drop is low.

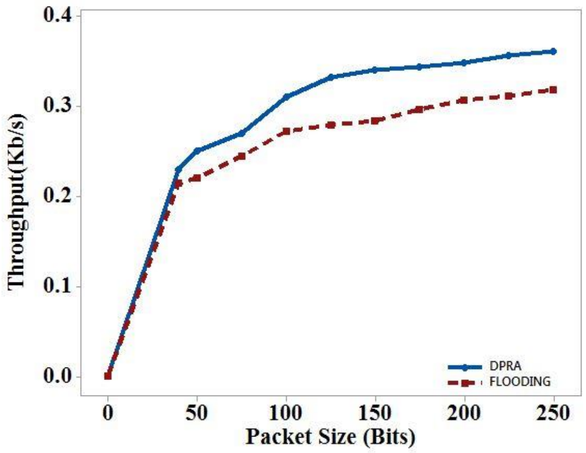


Figure 12: Throughput

Throughput is the measure of performance of the network. Figure 12 shows the throughput of the network concerning packet size for flooding and DPRA protocols. Increase in throughput represents the increase in the data flow rate. The throughput depends on the networks data rate measured in Kb/s. It measures the amount of data transferred in the network in unit time. The maximum throughput of 361Kb/s is achieved by the DPRA algorithm for the packet size of 250 bits.

Table 2: Delay measured in Hardware Environment

Packet size	DPRA	Flooding
8	34090	36492
12	36226	37476
16	37471	38194
20	38055	40847
24	40562	44584
30	41481	43317

Table 2. Highlights the measured delay under varying packet sizes. The end to end delay is measured in µsand the size of packet is expressed as bits. It is observed that the end to end delay is slightly high during hardware implementation when compared to the delay measured during simulation due to real – time collisions.

Table 3: Data rate measurement

Distance in Meters	Bandwidth (Mbps)	
	DPRA	Flooding
25	1.32	0.92
30	1	0.84
35	0.87	0.76
40	0.58	0.51
45	0.4	0.35

Table 3.shows the bandwidth of the communication between source node and the destination node in the network. Here the distance between the sender and the destination nodes remain unchanged. The data packet is routed through the intermediate nodes and the data rate is measured. It is observed that the flooding within the wireless network effects the data rate significantly.

IV. CONCLUSION:

A dynamic probabilistic routing algorithm is used in those networks where the nodes in the network are mobile in nature. The dynamic probabilistic routing algorithm maintains a probability value to control the duplicated packets retransmitted all over the network. The number of nodes in the neighbourhood of a broadcasting node will influence the routing decision since the retransmission probability is set by the algorithm based on this parameter. The method is implemented in the NS2 simulator, and the performance metrics are generated compared with the traditional flooding algorithm. The results show that the dynamic probabilistic routing algorithm provides lesser rebroadcast than the flooding mechanism. The performance and efficiency of the mobile ad-hoc network are increased by 17.64%. In order to increase the efficiency of DPRA the hybrid dynamic advanced algorithm will be proposed in future.

REFERENCE:

[1] G.V. Kumar, Y.V. Reddyr, Dr.M. Nagendra, “Current Research Work on Routing Protocol for MANET: A Literature Survey”, International Journal on Computer Science and Engineering (IJCSE), Vol. 2(3), 2013.

[2] Mushin Ur Raman Salfia,“STUDY OF MOBILE AD-HOC NETWORKS -ISSUES AND CHALLENGES”, International Journal of Advanced Research in Computer Science,Volume 6, No. 7, September-October 2015

[3] M. Scott Corson, Joseph P Macker, Gregory H Cirincione, “Internet-based Mobile Ad Hoc Networking”, IEEE Internet Computing Magazine, July/Aug 1999.

[4] Rajesh Sharma, Seem Sabharwal,“Dynamic Source Routing Protocol” International Journal of Advanced Research in Computer Science and Software Engineering,Volume 3, Issue 7, July 2013.

[5] I. Woungang, “Defending Against Collaborative Attacks by Malicious Nodes in MANETs: A Cooperative Bait Detection Approach”, *IEEE Systems*, Vol. 9, No. 1, pp. 65–75, 2015.

[6] D. Kim, H. Bae and C. K. Toh, “Improving TCP-Vegas performance over MANET routing protocols”,*IEEE Trans. Veh. Technol.*, Vol. 56, No. 1, pp. 372–377, 2007.

[7] S. Surendran and S. Prakash, "An ACO Look-

Published By:
Blue Eyes Intelligence Engineering & Sciences Publication

shows Approach to Q O S Enabled Fault-Tolerant Routing in MANETs",*China Commun.*, Vol. 18, No. 2, pp. 93–110, 2015.

[8] M. Aamir and M. A. Zaidi, "A Buffer Management Scheme for Packet Queues in MANET",*Tsinghua Sci. Technol.*, Vol. 18, No. 6, pp. 543–553, 2013.

[9] Zheng-Yu, Wu Han-Tao Song,"Ant-based Energy-aware Disjoint Multipath Routing Algorithm for MANETs",*The Computer Journal*, Volume 53, Issue 2, 1 February 2010, Pages 166–176.

[10] Z. Y. Wu and H. T. Song, "Ant-based energy-aware disjoint multipath routing algorithm for MANETs",*Comput. J.*, Vol. 53, No. 2, pp. 166–176, 2010.

[11] E. Y. Hua and Z. J. Haas, "An algorithm for prediction of link lifetime in MANET based on Unscented Kalman Filter",*IEEE Commun. Lett.*, Vol. 13, No. 10, pp. 782–784, 2009.

[12] J. Zhang, X. Wang, X. Tian, Y. Wang, X. Chu, and Y. Cheng, "Optimal multicast capacity and delay tradeoffs in MANETs," *IEEE Trans. Mob. Comput.*, vol. 13, no. 5, pp. 1104–1117, 2014.

[13] S. A. Abid, M. Othman, and N. Shah, "Exploiting 3D structure for scalable routing in MANETs," *IEEE Commun. Lett.*, vol. 17, no. 11, pp. 2056–2059, 2013.

[14] S. A. Abid, M. Othman, N. Shah, M. Ali, and A. R. Khan, "3D-RP: A DHT-based routing protocol for MANETs," *Comput. J.*, vol. 58, no. 2, pp. 258–279, 2013.

[15] Shivashankar, H. N. Suresh, G. Varaprasad, and G. Jayanthi, "Designing energy routing protocol with power consumption optimization in MANET," *IEEE Trans. Emerg. Top. Comput.*, vol. 2, no. 2, pp. 192–197, 2014.

[16] C. Tang, A. Li, and X. Li, "When Reputation Enforces Evolutionary Cooperation in Unreliable MANETs," *IEEE Trans. Cybern.*, vol. 45, no. 10, pp. 2190–2201, 2015.

[17] W.-K. Kuo and S.-H. Chu, "Energy Efficiency Optimization for Mobile Ad Hoc Networks," *IEEE Access*, vol. 4, no. 3, pp. 928–940, 2016.

[18] K. Chen, H. Shen, and H. Zhang, "Leveraging Social Networks for P2P Content-Based File Sharing in Mobile Ad Hoc Networks," *2011 IEEE Eighth Int. Conf. Mob. Ad-Hoc Sens. Syst.*, vol. 13, no. 2, pp. 112–121, 2011.

[19] R. A. Rehman and B. S. Kim, "LOMCF: Forwarding and Caching in Named Data Networking Based MANETs," *IEEE Trans. Veh. Technol.*, vol. 66, no. 10, pp. 9350–9364, 2017.

[20] U. Ghosh and R. Datta, "A Secure Addressing Scheme for Large-Scale Managed MANETs," *IEEE Trans. Netw. Serv. Manag.*, vol. 12, no. 3, pp. 483–495, 2015.

[21] J. Liu, X. Jiang, H. Nishiyama, and N. Kato, "Throughput capacity of MANETs with power control and packet redundancy," *IEEE Trans. Wirel. Commun.*, vol. 12, no. 6, pp. 3035–3047, 2013.

[22] X. Wu, H. R. Sadjadpour, and J. J. Garcia-Luna-Aceves, "Link dynamics in MANETS restricted node mobility: Modeling and applications," *IEEE Trans. Wirel. Commun.*, vol. 8, no. 9, pp. 4508–4517, 2009.

[23] Z. Ji, W. Yu, and K. J. R. Liu, "A belief evaluation framework in autonomous MANETs under noisy and imperfect observation: Vulnerability analysis and cooperation enforcement," *IEEE Trans. Mob. Comput.*, vol. 9, no. 9, pp. 1242–1254, 2010.

[24] Y. Fang, Y. Zhou, X. Jiang, and Y. Zhang, "Practical Performance of MANETs under Limited Buffer and Packet Lifetime," *IEEE Syst. J.*, vol. 11, no. 2, pp. 995–1005, 2017.

[25] S. Jiang, D. He, and J. Rao, "A prediction-based link availability estimation for routing metrics in MANETs," *IEEE/ACM Trans. Netw.*, vol. 13, no. 6, pp. 1302–1312, 2005.

[26] Chao Chen, Baoyu Zheng, and Xianjing Zhao. An ad hoc cooperative routing algorithm based on optimal channel selection. In Wireless, Mobile and Multimedia Networks, 2006 IET International Conference on, pages 1-4, Nov 2006

[27] Pak. J. Biotechnol. Vol. 14 (Special Issue II) Pp. 109- 111 (2017) Karpagam M. and D. Devi 109 cooperative protocol for QOS routing in wireless sensor networks M. Karpagam, D.Devi pp109-111

[28] Kai Zeng, Kui Ren, Wenjing Lou, and Patrick J. Moran. Energy-aware geographic routing in lossy wireless sensor networks with environmental energy supply. In Proceedings of the 3rd International Conference on Quality of Service in Heterogeneous Wired/Wireless Networks, QShine '06, New York,NY, USA, 2006. ACM

[29] Stefanov and E. Erkip. Cooperative information transmission in wireless networks. In in Proc. AsianEur. Workshop Inf. Theory, Breisach, Germany,June ,2002.

[30] Xiaohua Li. Energy efficient wireless sensor networks with transmission diversity. Electronics Letters, 39(24):1753-1755, Nov 2003.