EFFECTIVE LOAD BALANCING METHOD IN AD HOC NETWORK USING PSO

Buvana M[1] Suganthi M [2] Muthumayil K[3]

[1]Associate Professor,Department of Computer Science and Engineering, PSNACET,Dindigul,Tamilnadu,India
[2]Associate Professor, Department of Electronics and Communication Engineering, TCE, Madurai, Tamilnadu, India
[3]Associate Professor,Department of Information Technology, PSNACET,Dindigul,Tamilnadu,India

ABSTRACT

A mobile ad-hoc network (MANET) is a self structured infrastructure less network of mobile devices connected by wireless. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Load balancing is a technique to share out workload across network links, to achieve maximize throughput, minimize response time, and avoid overload. Load imbalance is a one of the critical issue in the ad-hoc network. Particle Swarm Optimization (PSO) method is used to implement our proposed technique. In this Paper two algorithms are used for balancing the nodes in the network. Identify the unfair nodes location next allocate and balance the load between the nodes in the network. The simulation results show that this approach is more effective in terms of packet delivery ratio, average end-to-end delay, load distribution, packet delay variation, packet reordering, and throughput.

KEYWORDS

dynamic MANET on-demand(DYMO);Lifetime prediction; Link lifetime (LLT); mobile ad hoc networks (MANETs);route discovery; particle swarm optimization(PSO).

1. INTRODUCTION

Mobile Ad hoc network is a self-adaptive infrastructure less network where nodes can be moved from one location to the other due to their dynamic nature. A number of literature works on the dynamic nature of MANETs have been done. The result is categorized into node lifetime routing algorithms and link lifetime (LLT) routing algorithms. Mans [2] describes that the nodes energy lost is happen due to its neighbouring data flows not only by its own. In [3], minimum total transmission power is used while selecting a path, and all nodes during these paths have sufficient residual battery energy. In the lifetime prediction routing (LPR) algorithm [5], used to assess the lifetime of nodes by means of well defined metrics. The LLT routing algorithms are used to choose the path with highest link lifetime. In [6], a link is considered to be stable when their lifetimes go beyond particular thresholds that depend on the relative speed of mobile nodes. A mobile node formulates a route request (RREQ), sent by a strong link. Particle swarm optimization (PSO) described in [11.In MANETs, a route consists of various links in sequence, and so, its lifetime depends on the lifetime of each node, in addition to the wireless links between adjacent nodes. Our work proposed to join node lifetime and link lifetime in our route lifetime-prediction algorithm, which examines the nodes energy drain rate and the relative mobility assessment rate at which neighbouring nodes travel apart in a route-discovery period that identifies the lifetime of routes that are discovered after that, we choose the longest lifetime route for data forwarding while selecting a route decision. The rest of this paper is organized as follows. Section II defines the route lifetime-prediction algorithm. Section III provides network control scheme with PSO. Section IV introduces the Particle swarm optimization algorithm. Section V presents the performance-evaluation results. Finally, Section VI depicts conclusions and presents future directions of this study.

2. OPERATION OF DYMO PROTOCOL

Dynamic MANET on-demand routing protocol is an easy and efficient routing protocol for multi hop networks .It discovers unicast routes among DYMO routers within the network in an on-demand fashion, the exactness of this protocol, digital signatures and hash chains are used. DYMO protocol consists of route discovery and route maintenance.

2.1. Route Discovery

The figure 1 shows how the sender sends the RREQ request to identify the path to the specified receiver. The path must be identified within the RREQ waiting time if it is not found search another route by distributing the nest request. To decrease congestion in a network, repeated tries at route discovery for a particular target node have to use an exponential bakeoff. Data packets awaiting a route must be buffered by the senders DYMO router. Buffer contains both positive and negative and predefined packets are removed first; hence buffer settings should be controlled. If a route discovery has been tried number times without receiving a route to the target node, all data packets planned for the related destination node are removed from the buffer and a Destination Unreachable ICMP message is disseminated to the source.

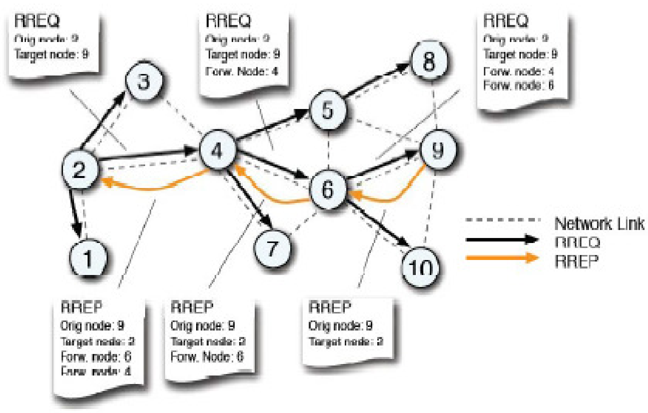

Figure 1. DYMO Route Discovery

2.2. Route Maintenance

Data packet is to be forwarded and it cannot be to the next-hop because no forwarding route for the IP Destination Address exists; an RERR is issued shown infigure.2.An ICMP Destination Unreachable message must not be generated unless this router is responsible for the IP Destination Address and that IP Destination Address is known to be unreachable. Furthermore, RERR should be issued after identifying a broken link of a forwarding path and promptly notify DYMO routers that a link break happen and that specific routes are no longer available.

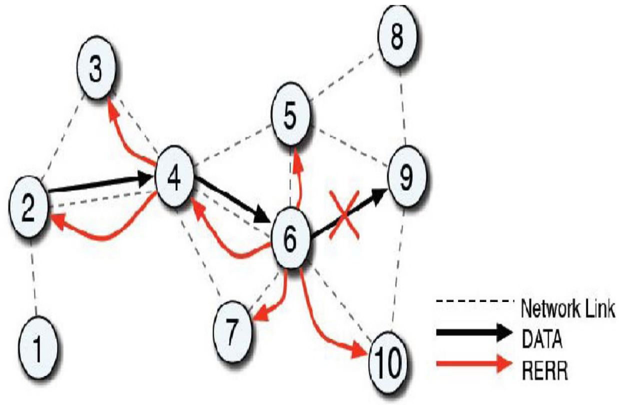

Figure 2. Route Error Message Generation and Dissemination

3. ROUTE LIFETIME PREDICTION ALGORITHM(RLT)

In RLT prediction, e*ci* refers that the connection between nodes *ni-1*and *ni*, then the lifetime of the link *li* is exp Link is created by two closest nodes which has the partial power and can travel freely. In MANET, a route consists of several links in series. The link lifetime is described as LLT in [6] – [8]. In this paper, the LLT includes NLT and the CLT. A link l_i consists of a connection c_i and two nodes (n_{i-1},n_i), as the minimum value of (Tci,Tn_{i-1},n_i), i.e,

Tli = min (Tci,$Tni-1$,ni). (1)

Let we consider the route p consisting of *N* links. Due to the limited energy and the mobility nature any one of the node is not alive. Hence the path p lifetime is very low. Thus, the lifetime *Tp* of route p can be expressed the following

Tp = min (Tni,Tci). (2)
ni€ Ω *(set of all nodes in the p)*
ci €Ψ(set of all links in p)

3.1 Node Lifetime Prediction Algorithm

Energy is the main factor to calculate the life time of the node. Node life time is predicted based on their residual energy. *Ei* means that the present residual energy of i[th] node, and *evi* is the rate of energy depletion of *i* [th] node. Every *T* seconds node *i* reads the instant residual energy *ei0*,*e*2 ,*e*3 ,...*e*(−1) ,*e* , . . ., in each period [0, T], [T, 2T], [2T, 3T], . . . ,[(N − 1)T, NT] . . ., and the energy drain rate is

ER =α e e T α EV, N > 1 (3)

ER i^N is the estimated energy depletion rate in the *N*th period, and N −1 i ER is the estimated energy drain rate in the (N − 1)[th] period. α denotes the coefficient that reflects the relation between Ni ER and N −1i ER, and it has the constant value at range of [0, 1] in our work we cn set the α is 0.5 . At *t* seconds, the estimated node lifetime as follows:

ER i = t ∈[NT , (N + 1)T]. (4)

3.2 Connection Lifetime Prediction Algorithm

Connection between two adjacent nodes is called link. We can easily evaluate the link lifetime by using connection lifetime. We evaluate the LLT using the connection lifetime; however, it is difficult to predict the connection lifetime T_{ci} between two nodes (n_{i-1},n_i) because the nodes in MANETs may move freely.

To calculate the lifetime of connection between two nodes (n_i and n_{i-1}), we should know about the distance between the two nodes and velocity of two nodes. It is very easy to calculate the distance between node n_i and n_{i-1}. To measure the received signal strength we can easily calculate the distance between two adjacent nodes. The relative motion of two nodes (n_{i-1} ,n_i) affecting at relative velocities v_i and v_{i-1} relative to ground at a given time t. The ground is used as a reference frame by default. If we think node n_i as the reference frame, node n_{i-1} is affecting at a relative velocity of $\vec{v}$, as given by the following:

$$\vec{v} = \vec{v}_{i-1} - \vec{v}_{I} \quad (5)$$

To compute the link lifetime T_{ci}, it utilizes the triangle geometry theory. To execute this requires three sample packets. This load balancing technique is reduces the time complexity and overhead. Figure. 3 illustrates the proposed LLT prediction

algorithm. If node n_i is set to the reference frame, node n_{i-1} moves at velocity $\vec{v}$ relative to the velocity of node n_i, n_{i-1} receives two packets from node n_i at time t_0 and t_1.

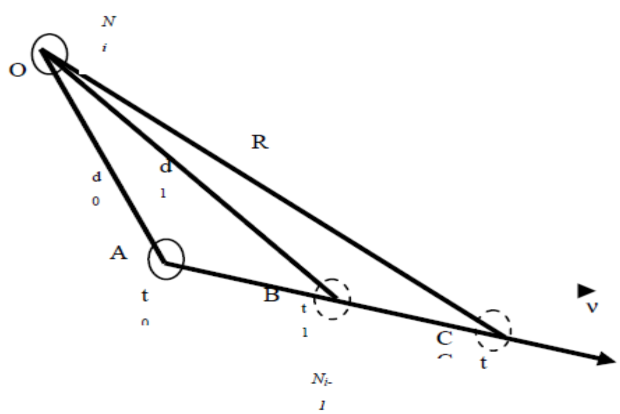

Figure 3. LLT Prediction Algorithm

We assume that node n_{i-1}moves out of node n_i's radio transmission range at prediction time t. At timet_0, node n_{i-1} receives a packet from node n_i, and the external signal power is P_0. $d_0$can be identified by using a radio-propagation model [9]. For an implementation we use NS-2 [10]. By means of the similar method, d_1 can also be calculated. Triangle problem is solved with the help of the law of cosine which is shown in Figure. 3:

$$d_1^2 = d_0^2 + [v(t_1-t_0)]^2 - 2d_0v(t_1-t_0)\cos\theta \quad (6)$$

$$R_1^2 = d_0^2 + [v(t-t_0)]^2 - 2d_0v(t-t_0)\cos\theta \quad (7)$$

Where $v = |\vec{v}_i|$, and R is the radio-transmission range. In Figure. 3,there is $S_{OAC} = S_{OAB} + S_{OBC}$, and it is converted into the following when we apply Heron's formula to it[$s = \sqrt{l(l - a)(l - b)(l - c)}$

] where the word *s* stands for the region of a triangle, the terms *a*,*b* and *c* signifies the three sides of the triangle, and $l = (a + b + c)/2$]:

$$(\sqrt{l_0(l_0-d_0)(l_0- R)(l_0-v(t-t_0))} = \sqrt{l_1(l_1-d_0)(l_1-d_1)(l_1-v(t_1-t_0))} + \sqrt{l_2(l_2-d_1)(l_2- R)(l_2-v(t-t_1))}) \quad (8)$$

Where l_0, l_1, $l_2$values are described in[8],which are all formulated by v and t, and then, there are three unknown parameters (t,v,θ) in (6)–(8).The residual connection time T_{ci} is calculated as $T_{ci} = t - t_1$. (9)

4. RESULTS AND DISCUSSION

4.1 Simulation Environment

For our experiments, we use a distinct event-driven simulator NS-2. Simulations parameters are shown in table 1.To calculate the outcome of mobility on the performance of routing protocols; we use the random waypoint model to follow the nodes mobility. A mobile node starts to move to a destination at a constant speed selected from a regular distribution, then stops for an already defined pause time, and repeat this process again. The initial energy and simulation time is set to 1000J, 200 s respectively. The assurance level is to 95%.

Table 1. Simulation Parameters

Parameter	**Value**
Network Size	1000x600m
No.of Nodes	50
MAC type	MAC 802.11
Radio Propagation	Two Ray Ground
Pause Time	0s
Max Speed	4m/s-24m.s
Initial Energy	1000J
Transmit Power	0.660W
Receive Power	0.4W
Idle Power	0.035W
Traffic Type	CBR
CBR Rate	512 Bytesx6 /sec
Max No. of Connections	25

4.2 Simulation Results

In this module, the performance of the DYMO_LLT_PSO is analyzed. Based on the analyzed results X-graphs are plotted. Throughput, delay, overhead is the basic parameters considered here and X-graphs are plotted for these parameters. Finally, the results obtained from this module are compared original DYMO protocol, and the DYMO with the DYMO_LLT mechanism and comparison X-graphs are plotted. Form the comparison result, final RESULT is concluded. The DYMO protocol tries to discover the minimum path between the source node to the destination node, discarding the node lifetime and wireless link lifetime. The particle swarm optimization algorithm is incorporated with LLT_PSO algorithm. This DYMO_LLT_PSO technique performs better compare to the other existing protocols.

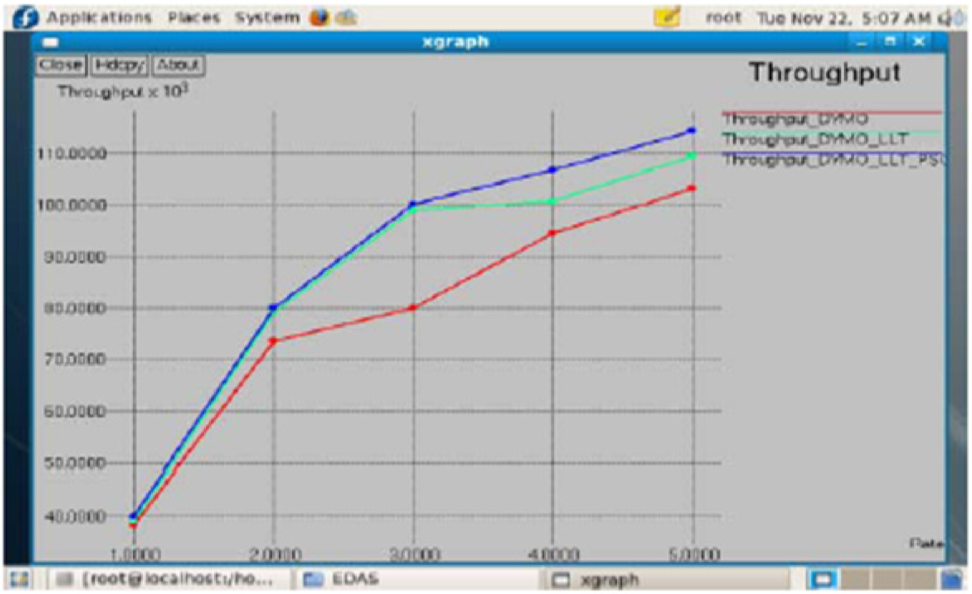

Figure 4. Throughput vs Velocity

Figure.4 shows the throughput performance for the three routing protocols in terms of packets. The proposed DYMO_LLT_PSO is good compare to the remaining two protocols in changing node velocity environments. DYMO_LLT_PSO throughput improvement is attained by about 1.8% compared by means of that of normal DYMO life time method.

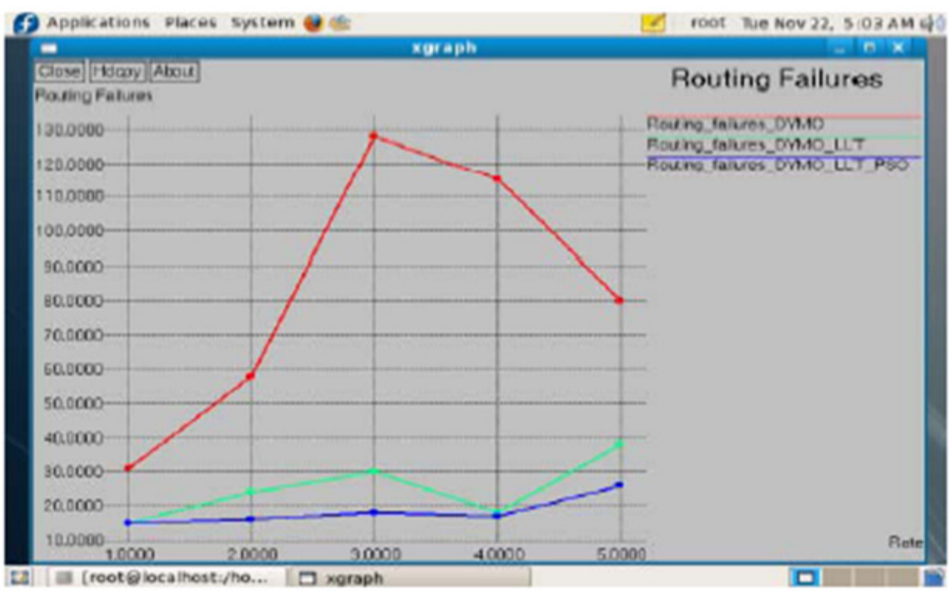

Figure 5. Route Failure vs Velocity

Figure.5 shows how the DYMO_LLT_PSO protocol is improved in the form of routing failures. To alter with dynamism varying network topology conditions, the DYMO_LLT_PSO, DYMO_LLT and DYMO protocols do their best to discover a more stable route, reducing the number of routing failures by 42.6% and 3.75% respectively, compared with that of the original DYMO and DYMO_LLT.

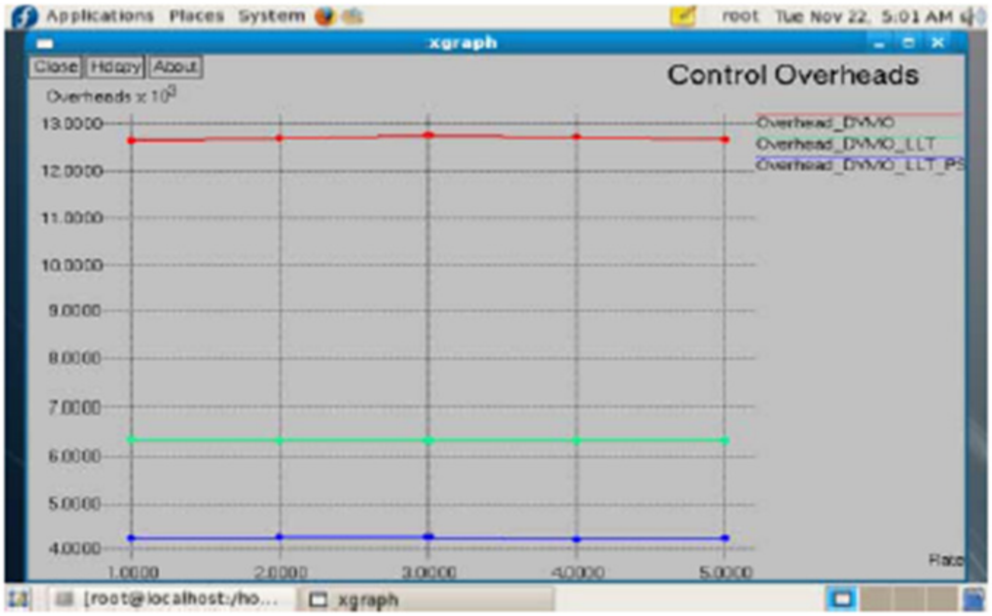

Figure 6. Routing Overhead vs Velocity

Figure.6 shows the routing overhead of theDYMO_LLT_PSO protocol gives an significant improvement by the use of our proposed RLP algorithm, and its overhead is reduced by 65.39% compared with that of the original DYMO and 17.7% compared with DYMO_LLT.

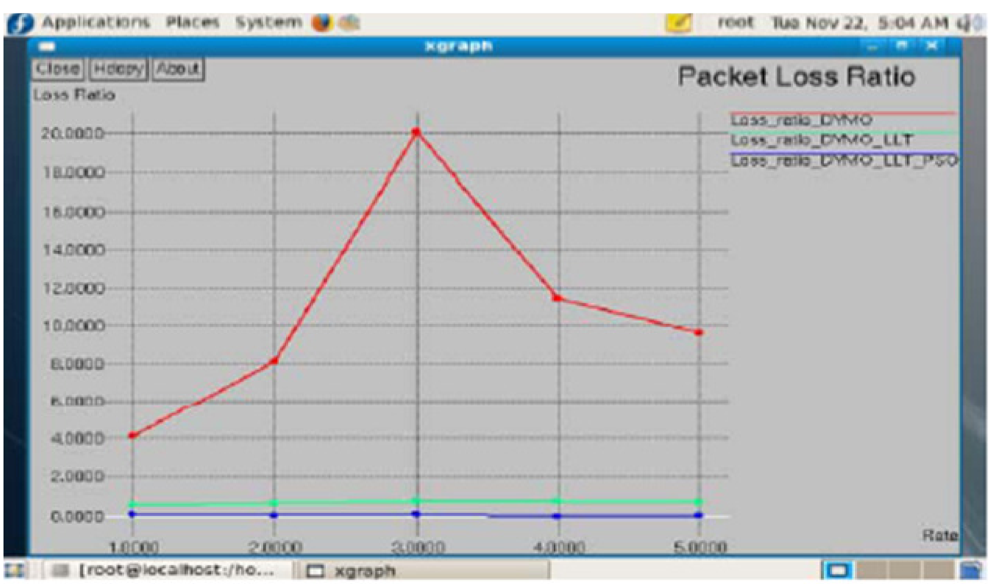

Figure 7. Packet Loss vs Velocity

Figure.7 shows the advantage of the DYMO_LLT_PSO protocol in terms of packet loss ratio. The DYMO_LLT_PSO protocol yields a significant improvement with the help of our proposed route lifetime-prediction algorithm with the particle swarm optimization algorithm, and its packet loss ratio is reduced by 51% compared with original DYMO, 5% compared with DYMO_LLT.

Figure 8. Packet Delivery Ratio vs Pause Time

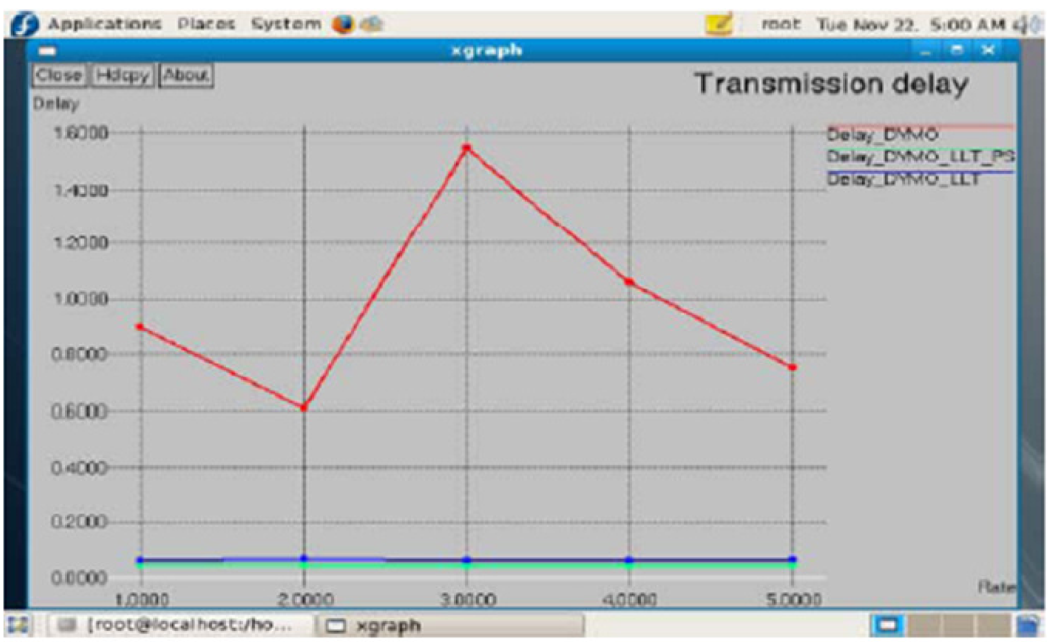

Figure 9. Transmission Delay vs. Velocity

Packet delivery ratio is shown in Figure.8 .The proposed DYMO_LLT_PSO protocol outperforms comparing to other protocols. Packet delivery ratio enhancement achieved by

DYMO_LLT_PSO is 10.6% compared with DYMO, 1.5%than DYMO_LLT.Figure.10 shows the advantage of the DYMO_LLT_PSO protocol in terms of transmission delay. To adapt to dynamically varying network topology environments, the DYMO_LLT_PSO have minimum transmission delay compared with that of the original DYMO and DYMO_LLT.

7. CONCLUSION AND FUTURE WORK

In Mobile Ad hoc Network nodes are connected by a link a path consists of multiple links. A link is nothing but connection between two neighbouring nodes which have limited battery energy and can roam freely. Node Link will be disconnected because of the nodes energy drain or out of each other's transmission range. Route lifetime depends on lifetime of node and lifetime of connection. The proposed work joins the LLT and LT and it is implemented in DYMO routing protocol.RLT prediction algorithm is incorporated with PSO to improve the performance. Simulation results show that the DYMO_LinkLifeTime PSO method do better compare to the DYMO and DYMO_LLT mechanism.

REFERENCES

[1] X. H. Wei, G. L. Chen, Y. Y. Wan, and X. M. Zhang ,(2006),Longest lifetime path in mobile ad hoc networks," J. Softw., vol. 17, no. 3, pp. 498–508.

[2] N. Shrestha and B. Mans,(2007), "Exploiting overhearing: Flow-aware routing for improved lifetime in ad hoc networks," in Proc. IEEE Int. Conf. Mobile Ad-hoc Sens. Syst., pp. 1–5.

[3] Toh.C.-K, (2001)"Maximum battery life routing to support ubiquitous mobile computing in wireless ad hoc networks," IEEE Commun. Mag., vol. 39,no. 6, pp. 138–147, Jun.

[4] Misra.A and Banerjee.S,(2002) "MRPC: Maximizing network lifetime for reliable routing in wireless environments," in Proc. IEEE WCNC, pp. 800–806.

[5] Maleki.M, Dantu.K, and Pedram.M,(2003) "Lifetime prediction routing in mobile ad hoc networks," in Proc. IEEE WCNC, pp. 1185–1190.

[6] C. K. Toh, "Associativity-based routing for ad hoc mobile networks," Wirel. Pers. Commun. Special Issue on Mobile Networking and Computing Systems", vol. 4, no. 2, pp. 103–139, Mar. 1997.

[7] Dube.R, Rais.D, Wang.K.Y, and Tipathi.S.K, "Signal stability based adaptive routing (SSA) for ad hoc mobile networks," IEEE Pers. Commun., vol. 4, no. 1, pp. 36–45, Feb. 1997.

[8] X. Wu, H. R. Sadjadpour, and J. J. Garcia-Luna-Aceves, "An analytical framework for the characterization of link dynamics in MANETs," in Proc. IEEE Mil.Commun. Conf., 2006, pp. 1–7.

[9] Sarkar.T.K, Ji.Z, Kim.K, Medouri.A, and Salazar-Palma.M, "A survey of various propagation models for mobile communication," IEEE Antennas Propag. Mag., vol. 45, no. 3, pp. 51–82, Jun. 2003.

[10] Johnson.D, Hu.Y, and Maltz.D, DSR:RFC 4728. [Online]. Available: http://www.ietf.org/rfc/rfc4728.txt

[11] Raghavendra V. Kulkarni, Ganesh K. Venayagamoorthy ,Ann Miller, and Cihan H. Dagli "Network-centric Localization in MANETs based on Particle Swarm Optimization" IEEE Swarm Intelligence Symposium St. Louis MO USA, September 21-23, 2008.

[12] Valarmathi, A. and R.M. Chandrasekaran, 2010. Congestion aware and adaptive dynamic source routing algorithm with load-balancing in MANETs. Int. J. Comput. Appli., 8: 1-4.

[13] M. Donelli, R. Azaro, F. D. Natale, and A. Massa, "An innovative computational approach based on a particle swarm strategy for adaptive phased-arrays control," IEEE Trans. on Antennas and Propagation, vol. 54, no. 3, pp. 888–898, Mar. 2006.

[14] V. Kumar, D. Rus, and S. Singh, "Robot and sensor networks for first responders," IEEE Pervasive Comput., vol. 3, no. 4, pp. 24–33, Oct–Dec 2004.

[15] C. Cassandras and W. Li, "Sensor networks and cooperative control," in Proc. and 2005 European Control Conference Decision and Control CDC-ECC '05. 44th IEEE Conference on, 12–15 Dec. 2005, pp. 4237– 4238.

[16] X. Hu, Y. Shi, and R. Eberhart, "Recent advances in particle swarm," in Proc. CEC2004 Evolutionary Computation Congress on, vol. 1, 19–23 June 2004, pp. 90–97

[17] Gole, S.V. and S.V. Mallapur,(2011). Multipath energy efficient routing protocol. Int. J Res. Rev. Comput. Sci., 2: 954-958.
[18] Amjad Ali, Wang Huiqiang,(2012) “Node Centric Load Balancing Routing Protocol for Mobile Ad Hoc Networks “Proceedings of the International MultiConference of Engineers & ;2012, Vol. 1, p366

Authors

M.Buvana has over 8.7 years of teaching experience and is currently working as a Associate Prof in PSNA College of Engineering and Technology. She finished her bachelor of Engineering (computer science) at PSNA College of engineering and Technology, Dindigul in the year 2004. And She completed her M.E in PSNA College of engineering and Technology in 2008. She published two papers in International journal and she has published papers in the 7 national and 5 International and IEEE conferences such as ICoAC 2011,ICICCA 2013,etc.. She is pursuing PhD degree in the field of Mobile communication at Anna University Chennai, India. She is the member of IEEE, ACM and life member of ISTE.

M.Suganthi is currently working as Professor of Department of Electronics and Communication Engineering in Thiyagaraja College of Engineering, Madurai. She graduated her B.E. in Electronics and Communication Engineering from Thiyagaraja College of Engireeing, Madurai, M.E. in Communication Systems from P.S.G College of Technology, Coimbatore, and Ph.D in Mobile Communication from Madurai Kamaraj University, Madurai. She has been an educator in the technical teaching society for the past 23 years. She has published various papers about the wireless communication in different conferences and journal and she has guided 6 research scholars.

K.Muthumayil was born in Tamilnadu, India in 1978. He received B.E., from Madurai Kamaraj University,Madurai, India in the year 2000 and M.E from Madurai Kamaraj University, Madurai, India in the year 2002. His area of interest includes mobile ad hoc networks and network security. He is having 13years of teaching experience in the department of Computer Science Engineering and Information Technology. He has published 7 research papers in international journals and presented 20 papers in national and international conferences. He is the member of IEEE, ACM and life member of ISTE.