Int. Journal of Precious Engineering Research and Applications
www.ijpera.com
ISSN : 2456-2734, Vol. 1, Issue 4, November 2016, pp.12-17

RESEARCH ARTICLE OPEN ACCESS

Efficient Interference Aware Multipath Dynamic Source Routing Protocol for Mobile Ad hoc Network

Nagaraj M. Lutimath[1], Suresh L[2] Chandrakant Naikodi[3]
[1]*Department of Computer Science and Engineering, SVCE, Bangalore, India*
[2,3]*Department of Computer Science and Engineering, Cambridge Institute of Technology, Bangalore, India*

ABSTRACT:
One of the important research characteristic in the Mobile Ad hoc NETworks (MANETs) is routing. Development of efficient routing protocol is a necessity to improve the performance of routing. We propose an Efficient Interference Aware Multipath Dynamic Source Routing Protocol (EIAM-DSR) based on Dynamic Source Routing (DSR) protocol for MANETs. The main aim of the proposed routing protocol is to select link-disjoint routes with the minimum interference between them. The efficiency of the protocol is studied in terms of the overall throughput and the packet delivery ratio. The Simulation of EIAM-DSR and DSR protocols is done using Java and results show that the proposed routing protocol has more packet delivery ratio and throughput compared with the interference aware Dynamic Source Routing Protocol.
Keywords: DSR, EIAM-DSR, Interference

I. INTRODUCTION

Multipath routing protocols discover and store more than one route in the routing table for the destination nodes. Due to mobility of wireless nodes, routes failure takes place frequently. The Data transmission links in wireless communication environment are inherently unreliable and error prone. A single path routing protocol suffers with these shortcomings. Interference is a disturbance caused between the sender and receiver nodes propagation signals. This happens when a node moves between any two nodes transmission sensing range. In carrier sensing range a node cannot decode the signals but can access them. During transmission of data, a channel is accessed by the node; the nodes within this node's carrier sensing range get affected. Multiple node or link disjoint path routing can be affective, but interference causes a significant drop in data transfer and throughput. Efficient interference aware protocol that minimizes the inference for routing along the path becomes a need.

II. LITERATURE SURVEY

We discuss the existing work done on multipath routing protocols. Multipath routing creates multiple paths between a source destination pair. In case of the failure of first route, the backup routes are used for continuing data transmission. In multipath routing protocols, the paths between a source and destination can be link disjoint, node disjoint or non disjoint [1]. Authors in [2] propose a scheme to find all Link disjoint paths from source to destination. NDM-AODV [2] considers the residual energy of nodes while selecting the multiple routes. The routing overhead to find multiple paths are kept minimum by using dynamic source routing (DSR) protocol like source routing in route discovery process. Many on-demand [3, 4, 5] and proactive [6, 7] multi-path routing protocols such as AOMDV [8], SR-MPOLSR [9], MP-OLSR [10] were proposed. These protocols did not address the problem of interference from source to destination. Hence interference plays an important role for the network performance such as data loss, conflict, retransmission of packets and so on. Reduction of interference [11, 12] on a path is a important problem in order to increase network performance. In MANET, interference [13, 14] is caused at neighbor nodes when a node data transmitted to them. There exist many definitions of interference but there have been still no common definition of it. Our aim is to initiate one definition of interference [15, 16, 17], and propose a formula of interference and to build a new link disjoint multi-path routing protocol that minimizes the interference. Earlier work was done considering link route expiry time [18] using node disjoint multipath, and then the work was continued to link disjoint without considering link route expiry time [19].

III. PROBLEM DEFINITION

Designing an efficient protocol that has an efficient packet delivery ratio and throughput is needed as there is interference between the source node and destination nodes. Interference is a disturbance caused between the sender and receiver nodes propagation signals. This happens because of the mobility of two nodes in transmission sensing range. In carrier sensing range a node cannot decode the signals but can access them. During transmission of data, a channel is accessed by the node; the nodes within this node's carrier sensing range get affected. Multiple node or link disjoint path routing can be affective, but interference causes a significant drop in data transfer and throughput. Thus the efficiency of multipath node or link disjoint path is decreased which is nearly equal to sharing the traffic load in a single route. As the traffic load increases in a single path, the packet delivery ratio and throughput of multi-path decreases resulting in a hidden terminal problem [6], even though there is a existence shared channel problem So we have considered the link disjoint multipath concept in designing the protocol with the link route expiry times to increase the efficiency of the typical dynamic source routing protocol.

IV. PROPOSED WORK

The proposed work is done using the following interference measurement and scheme.

A. Measurement of Interference

Interference of a given node changes with distance from that node to neighbour nodes in its interference range. Interference of a given node is calculated, by dividing the whole interference region of a node is divided into smaller interference regions of the node. To explain this we have considered interference as a circle with a radius of T_c with the node o in the centre and using the equation [10].

The following equations are used for calculation of interference intensities.

$$I_r = I_t \quad J_t \quad J_r \quad K_t^2 \quad K_r^2/x^k \quad (1)$$

In equation (1), J_t and J_r are the antenna gains of transmitter and receiver, respectively. I_t is the transmission power of a sender node. K_t and K_r are the heights of the transmitter and receiver antenna respectively. We have assumed that the MANET is homogeneous and all the radio parameters are same at each node.

$x=(I_tJ_tJ_rK_tK_r/D_2^k)/(I_tJ_tJ_rK_tK_r/D_1^k)=0.5^k$
$y=(I_tJ_tJ_rK_tK_r/D_3^k)/(I_tJ_tJ_rK_tK_r/D_1^k)=0.33^k$

Common path loss model used in wireless networks is the open space path loss which has k equal to 2 is assumed. Therefore, x=0.25, y=0.11, and

$$L(o) = p1+ 0.25p2 + 0.11p3 \quad (2)$$

Based on the formula of interference of a node we can calculate the interference of a link. For a link interconnecting two nodes a and b, m= (a, b), L(a) and L(b) are the interferences of node a and node b respectively, we have:

$$L(f) = (L(a) +L(b))/2 \quad (3)$$

Based on the calculation of interference of a link, we can calculate the interference of a path P that consists of links f1, f2... fn as follows.

$$L (P) =L(f1) + L (f2) + ... + L (fn) \quad (4)$$

We now explain the principle of finding the interference multipath.

In a MANET, multiple paths can be divided into three types:

- Node-disjoint multiple paths: there exists is a common source and destination nodes in the paths.
- Link-disjoint multiple -paths: there are a few common nodes but not links in that are shared by the paths.
- Hybrid multi-route: the paths share common links and nodes in the paths.

Link-disjoint multiple path is used with DSR

Following steps are performed in finding the efficient path.

B. Scheme

Step 1: A given topology of a MANET is taken and a single path with least interference based on the DSR algorithm is found.

Step 2: The next least interference path is found by using the DSR procedure again by considering link disjoint concept between the source and destination in the path found in step 1.

Step 3: The DSR algorithm is repeated for a number of times for a given value of k, where k=1 to n by avoiding the nodes between the source and destination along the paths found in the previous steps to find k-minimum interference path.

Step 4: If there are more than one path with the same minimum interference value then the route link expiry time is taken to find the efficient path from a given source to destination.

The scheme is explained below with an example.

Consider the following MANET topology in Fig 1, with the numerical interference values mentioned and link expiry times given within the brackets.

Int. Journal of Precious Engineering Research and Applications
www.ijpera.com
ISSN : 2456-2734, Vol. 1, Issue 4, November 2016, pp.12-17

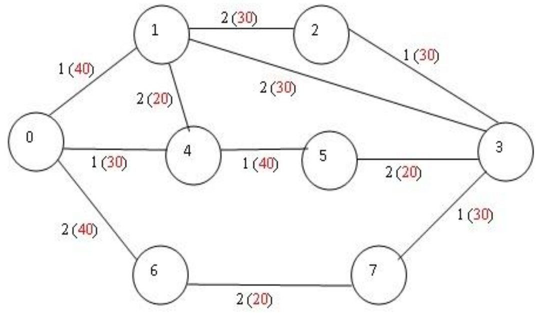

Fig 1: MANET with interference values and link expiry times

When DSR algorithm is used at the first time, Fig 1 weighted graph with source S=0 and destination D=3 we get the minimum interference path 0-1-2-3 that has the path interference value of 4.Using the DSR algorithm once more, we get the second minimum interference path 0-4-1-2-3 with the path interference value of 6. We continue to apply the DSR algorithm and find the third path 0-4-1-3 with the interference value of 5. We continue to apply the DSR algorithm and find the fourth path 0-4-5-3 with the interference value 4. We continue to apply the DSR algorithm and find fifth interference path with interference 5. The minimum interference paths of these paths are 0-1-2-3 and 0-4-5-3 with interference value of 4. As there are two paths with the same minimum interference value we consider the link expiry times along the paths. The minimum link expiry time along the path 0-1-2-3 is 30. This is calculated by finding the minimum of the link expiry times along the path 0-1-2-3 which are 40, 30 and 30. Similarly the minimum link expiry time along the path 0-4-5-3 is 20, which is the minimum of 30, 40 and 20. We then find the greater of the minimum expiry times along those paths 0-1-2-3 and 0-4-5-3. That is greater of values 30 and 20. The value is 30. Thus the efficient path is 0-1-2-3.

V. SIMULATION AND EVALUATION

The proposed routing protocol EIAM-DSR is compared with typical DSR protocol. Simulation is done using Java program. Packet Delivery Ratio (PDR) and throughput are taken as simulation performance parameters. PDR is defined as the ratio of number of packets received to the number of packets sent from a given source to destination. Throughput is the number of packets received by destination per unit time. Simulation is performed considering the parameters identified in the Table I below.

Table I: Simulation Parameters with their corresponding values

Parameter Type	**Parameter Value**
Simulation Iterations	10
Simulation terrain (m x m)	Varies from 250m x 250m to 1000m x 1000m
Seed Values	1to 10
Number of Nodes	100 to 500
Mobility Model	Random Waypoint
Propagation Model	Free Space
Channel Bandwidth	4Mbps
Transmission Range	Varies from 250m to 350m
Packet Size	512byte
Transport Protocol	UDP

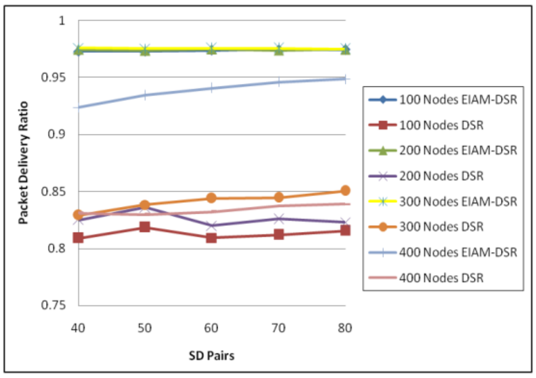

Fig 2: Packet Delivery Ratio vs. SDPairs for transmission range of 250m

Fig 2 shows the packet delivery ratio results for 250m transmission range. In the Fig 2 EIAM-DSR the Packet Delivery Ratio for DSR is 0.809 for 100 nodes with 40 SD Pairs. EIAM-DSR it is 0.9729 which is 20 percent higher than DSR.Similarly packet delivery ratio for DSR is 0.836 for 200 nodes with 50 SD Pairs.E IAM-DSR it is 0.9733 which is 16 percent higher than DSR. This is because a efficient minimal interference path formed by intereference multipath is taken for packet delivery in EIAM-DSR protocol. The packet delivery ratio in EIAM-DSR is 0.9485 for 80 SD pairs with 400 nodes but it is 0.9237 for 400 nodes and 20 SD pairs. The reason behind this is that that SD Pairs for 300 nodes and 400 nodes are not same and the intereference path for 400 nodes is more than 400 nodes for 20 SD Pairs.Further in the graph we observe that the packet delivery ratio in EIAM-DSR is 0.9733 for 50 SD Pairs and 200 nodes , it rises to 0.9736 for 70 SD Pairs. This is because intereference for 50 SD Pairs is more than 70 SD

Pairs for 200 nodes.Comparing EIAM-DSR with DSR with given SD Pair and nodes. We find that packet delivery ratio for EIAM-DSR is more than DSR. Fig 3 shows the packet delivery results for 320m transmision range.

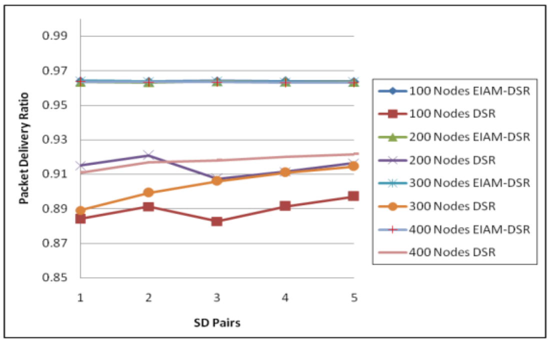

Fig 3: Packet Delivery Ratio vs. SD Pairs for transmission range of 320m

In the Fig 3 EIAM-DSR the Packet Delivery Ratio for DSR is 0.8826 for 100 nodes with 60 SD Pairs. EIAM-DSR it is 0.9641 which is 9.2 percent higher than DSR.. Similarly packet delivery ratio for DSR is 0.9167 for 400 nodes with 50 SD Pairs. In case of EIAM-DSR it is 0.9633 which is 5 percent higher than DSR. This is because a minimal interference path formed by intereference multipath is taken for packet delivery in EIAM-DSR protocol. The packet delivery ratio in EIAM-DSR is 0.9631 for 50 SD pairs with 200 nodes but it has increased to 0.9633 for 200 nodes and 70 SD pairs. The reason behind this is that that 50 SD Pairs for 200 nodes exibit more interference than and 70 SD Pairs for 200 nodes. We find that packet delivery ratio for EIAM-DSR is more than DSR Fig 4 shows the Throughput results for 250m transmision range.

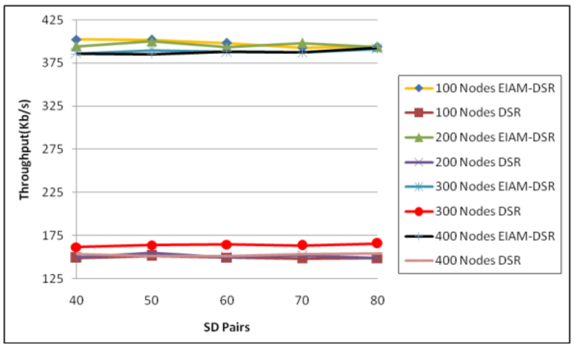

Fig 4: Throughput vs. SDPairs for transmission range of 250m

.

In the Fig 4 EIAM-DSR the Throughput for DSR is 149.5Kb/s for 100 nodes with 60 SD Pairs. EIAM-DSR it is 398.2Kb/s which is 248.7 higher than DSR.. Similarly Throughput for DSR is 164Kb/s for 300 nodes with 50 SD Pairs. In case of EIAM-DSR it is 389.68Kb/s which is 225.68 higher than DSR. This is because a minimal interference path formed by intereference multipath is taken for packet delivery in EIAM-DSR protocol. The Throughput in EIAM-DSR is 388Kb/s for 60 SD pairs with 300 nodes but it is 388.366Kb/s for 400 nodes and 60 SD pairs. The reason behind this is that that SD Pairs for 300 nodes exibit more interference than and 400 nodes. There are some broken paths in case of 300 nodes with 60 SD Pairs. Further in the graph we observe that the Throughput in EIAM-DSR is 385.26Kb/s for 50 SD Pairs and 400 nodes , it rises to 388.26Kb/s for 60 SD Pairs. This is because interference produced by 50 SD pairs is more than 60 SD Pairs. The 50 SD Pairs and 60 SD Pairs are not same. Further comparing EIAM-DSR with DSR with given SD Pair and nodes. We find that Throughput for EIAM-DSR is more than DSR Fig 5 shows the Throughput results for 320m transmision range

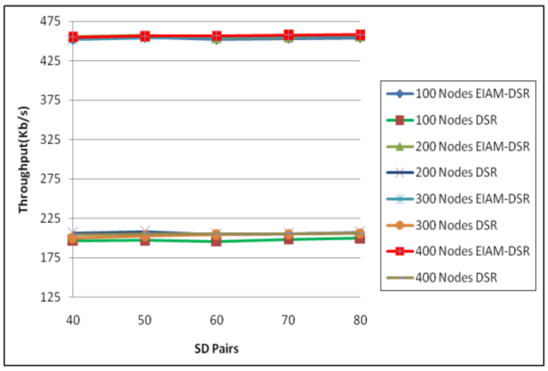

Fig 5: Throughput vs. SDPairs for transmission range of 320m

In the Fig 5 EIAM-DSR the Throughput for DSR is 208Kb/s for 200 nodes with 50 SD Pairs. EIAM-DSR it is 457.17Kb/s which is 249.1 higher than DSR.. Similarly Throughput for DSR is 199.37Kb/s for 300 nodes with 40 SD Pairs. In case of EIAM-DSR it is 451.82 Kb/s which is higher than DSR. This is because a minimal interference path formed by intereference multipath is taken for packet delivery in EIAM-DSR protocol. The Throughput in EIAM-DSR is 456.6Kb/s for 60 SD pairs with 400 nodes but it is 457.77Kb/s for 400 nodes and 70 SD pairs. The reason behind this is that that 60SD Pairs for 400 nodes exibit more interference than 70 SD Pairs and 400 nodes. There are some broken paths in case of 400 nodes with 60 SD Pairs. Further in the graph we observe that the Throughput in EIAM-DSR is 451.899Kb/s for 60 SD Pairs and 100 nodes , it rises to 453.399Kb/s for 70 SD Pairs. This is because interference produced by 60 SD pairs is more than 70 SD Pairs. The 60 SD Pairs and 70 SD Pairs are not same. Further comparing EIAM-DSR with DSR with given SD Pair and nodes. We find that Throughput for EIAM-DSR is more than DSR.From the observations from the results of Fig 2,Fig 3, Fig 4, and Fig 5 we conclude that Packet Delivery Ratio and Throughput of EIAM-DSR is more than DSR.

VI. CONCLUSION

In this paper, we have proposed an efficient link disjoint multi-path routing protocol EIAM-DSR based on interference aware DSR for mobile ad-hoc network. EIAM-DSR uses link-disjoint path with a minimal interference and considers link expiry times to increase the performance of data transmission between a source and a destination. With simulation we have shown that EIAM-DSR is better than DSR in terms of Packet Delivery Ratio and Throughput. In future to our protocol will be enhanced using the network performance.

REFERENCES

[1] Mohammed Tarique, Kemal E. Tepe, Sasan Adibi, and Shervin Erfani. “Survey of Multipath Routing Protocols for Mobile ad hoc Networks“, Journal of Network and Computer Applications, pp. 1125 – 1143, 2009.

[2] Shunli Ding and Liping Liu. “A node disjoint multipath routing protocol based on aodv“, In Distributed Computing and Applications to Business Engineering and Science (DCABES), 2010 Ninth International Symposium, pages 312 -316, August 2010

[3] David B. Johnson, David A. Maltz, Josh Broch, “DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks,” *Ad Hoc Networking, Addison-Wesley, 2001:139-172.vol. 4,* 2001, 139-172.

[4] C. E. Perkins and E. M. Royer. Ad Hoc On Demand Distance Vector (AODV) Routing. Draft-ietf-MANET-aodv-02.txt, Nov. 1998. (work in progress).

[5] Perkins CE, Royer EM. Ad-Hoc on demand distance vecto routing.In: IEEE Work-Shop on Mobile Computing Systems and Applications (WMCSA). New Orleans, 1999.

[6] Perkins CE, Bhagwat P. Highly dynamic destination-sequenced distance-vector routing (DSDV) fo mobile computers. In *Proceedings of ACM Sigcomm*, 1994.

[7] Park VD, Corson MS. A highly adaptive distributed routing algorithm for mobile wireless networks. In Proceedings of IEEE Infocom,1997.

[8] Marina, M. K. and Das, S. R., “On-demand Multipath Distance Vector Routing for Ad Hoc Networks,” Proc. of 9th IEEE Int. Conf. on Network Protocols, pp.14-23 (2001).

[9] X. Zhou, Y. Lu, B. Xi, A novel routing protocol for ad hoc sensor networks using multiple disjoint paths, in: 2nd International Conference on Broadband Networks, Boston, MA, USA, 2005.

[10] S.J. Lee and M. Gerla, “Split Multipath Routing wit Maximally Disjoint Paths in Ad Hoc Networks,” IEEE International Conference On Communications, (ICC2001), Helsinki, 11-14 June 2001, pp. 3201-3205.

[11] K. Moaveni-Nejad and X. Li. “Low-interference topology control for wireless ad hoc networks. Ad Hoc& Sensor Wireless Networks”: an International Journal, 2004. Paths in Ad Hoc Networks”, IEEE ICC 2001, 2001, pp. 3201-3205.

[12] Kui Wu and Janelle Harms. “On-Demand Multipath Routing for Mobile Ad Hoc Networks”. EPMCC 2001.1-6.

[13] Xinming Zhang, Qiong Liu, Dong Shi, Yongzhen Liu, Xiang Yu “An Average Link Interference-aware Routing Protocol for Mobile Ad hoc Networks ”,,Conference on Wireless and Mobile Communications(ICWMC'07).

[14] T. Clausen, P. Jacquet, IETF Request for Comments: 3626, “Optimized Link State Routing Protocol OLSR”, October 2003.

[15] Xu Yi, Cui Mei, Yang Wei, Xan Yin “A node-disjoin Multipath Routing in Mobile Ad hoc Networks”, IEEE, 2011.

[16] Phu Hung Le, Guy Pujolle, Thi-Mai-Trang Nguyen “An Interference-aware multi-path routing protocol for Mobile Adhoc Network”, Proc of International Conference on Networking, Sensing and Control Delft, the Netherlands, 11-13 April 2011.

[17] Eman S. Alwadiyeh, Ala’ F A Aburumman, “Interference-Aware Multipath routing protocols for Mobile Ad hoc Networks””, 13th Annual IEEE workshop on Wireless Local Networks 2013.

[18] Nagaraj M. Lutimath, Suresh L, Chandrakant Naikodi, “Interference-

Aware Node Disjoint Multipath Dynamic Source Routing Protocol for MANETs". International Journal of Advanced Computational Engineering and Networking, ISSN: 2320-2106, Volume-3, Issue-1, Jan.-2015.pp.27-30

[19] Nagaraj M. Lutimath, Suresh L, Chandrakant Naikodi, "Efficient Power Aware Multipath Routing Protocol for Mobile Ad-hoc Networks". International Conference on Circuits, Control, Communication and Computing. 4th - 6th October 2016, MSRIT, Bangalore-54, pp.168-171.