ISSN 2229-5518

On Reducing the Route Discovery Overhead in DSR Protocol using Rough Set theory

S. Sathish, K. Thangavel

Abstract— The design of ad-hoc routing protocols has received a lot of attention due to the rapid and unpredictable mobility of a node. Protocols were designed to overcome the overhead in maintaining unused information and that helps to improve the performance. Mobile Ad hoc NETwork (MANET) is a collection of wireless mobile nodes that can dynamically form a network. This definition implies that there is no permanent topology, centralized administration and standard support services. Broadcasting the route request enables the overhead in reactive routing protocol. The DSR (Dynamic Source Routing) protocol is sending route request packet to all the neighbor nodes when it needs to find destination. It will totally diminish the performance of network and consumes much of the bandwidth. In this paper, we made an attempt to reduce route request packets in multicast by using equivalence classes of rough set theory among the neighbors of a node. Simulations show that the new modified algorithm performs better than the DSR and Enhanced-DSR algorithm.

Index Terms— DSR, E-DSR, RREQ, RREP, Rough set and Equivalence Class.

1 INTRODUCTION

Ad hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration [1]. Adhoc networks are increasingly popular because it provides efficient access to the information and communication. The nodes in ad hoc networks are highly co-operative. There is no need for router because each node can work as a host as well as router accordingly. Each node or mobile device is equipped with a transmitter and receiver. The topology of mobile ad-hoc network is dynamic and it can change rapidly and unexpectedly. Ad-hoc networks have to suffer many challenges at the time of routing, the information system of rough set theory is used to find the equivalence nodes based on the properties of node. Source node floods the route request packet only to the selected node that will reduce the overhead of route discovery.

1.1 Routing in Mobile Adhoc Networks

Routing is a process of finding paths in a network through which data is sent. Routing of data is one of the major issues in mobile ad hoc networks. A number of routing protocols have been proposed for MANETs [2]. Most of the routing protocols in MANETs are either proactive or reactive. Proactive methods can be further classified into two namely link state and distance vector. Proactive protocols (table driven) continuously evaluates the routes within the network. Protocols forward the packet immediately when the route is already in routing table otherwise it will significantly discover the route. In reactive (on demand) protocols a route is found for a destination only when there is a need to send information to the destination. Discovering the route in on demand avoids the cost of maintaining routes that are not being used and also controls the traffic of the network. Because it doesn't send excessive control messages which significantly create a large difference between proactive and reactive protocols.

S.Sathish, Periyar University, Salem, Tamilnadu, India.636 011 sathishkgm@yahoo.com, 98654 13993

Dr.K. Thangavel, Periyar University, Salem, Tamilnadu, India-636011.drktvelu@yahoo.com,9486237009.

1.2 Overview of DSR Protocol

The Dynamic Source Routing protocol (DSR) [3] is based on source routing, which means that the originator of each packet determines an ordered list of nodes through which the packet must pass while traveling to the destination. The DSR protocol consists of two basic mechanisms: Route Discovery and Route Maintenance.

1.3 Route Discovery

When the source node has data packets to be sent to that destination, it initiates a Route Request packet. This Route Request is flooded throughout the network. Each node, upon receiving a route request packet, rebroadcasts the packet to its neighbors if it has not forwarded already or if the node is not the destination node, provided the packet's time to live counter not exceeded. Each RREQ packet carries a sequence number and the path it has traversed. Node checks the sequence number on the packet before forwarding it. The packet is forwarded only if it is not a duplicate one. It is used to prevent loop formations and to avoid multiple transmission of the same RREQ packet by an intermediate node that receives it through multiple paths. Thus all nodes except the destination forward a RREQ packet during the route construction phase. A destination node, after receiving the first RREQ packet replies to the source node through the reverse path the RREQ packet had traversed. A route cache that stores all possible information extracted from the source route contained in a data packet. This route cache is also used during the route construction phase. If an intermediate node receiving a RREQ packet has a route to the destination in its route cache, then it replies to the source node by sending a Route Reply with the entire route information from the source node to the destination node.

1.4 Route Maintenance

DSR protocol implements the route maintenance mechanism while communicating the packets from source to destination. But, when the communication link between the source and the destination is broken or else a change in network topology is noticed. It will lead to failure of the communication between source node and destination node. In this scenario, DSR protocol uses the route mechanism, to detect any other possible known route towards the destination to transmit data. If the route maintenance fails to find an alternative known route to establish the communication then it will invoke the route discovery to find the new route to destination.

1.5 Rough set theory

In Rough Set Theory [4], a data set is represented as a table, where each row represents an element. Each column represents an attribute that can be measured for an element .This table is called an information system. The set of all elements is known as the universe.

Consider a Universe U of elements. Formally an information system I is a quadruple I = (U, A, V, ρ), where

A is a non empty finite set of attributes

$V = \bigcup_{a \in A} V_a$ is the set of attribute values of all attribute, where V_a is the set of possible values of a

$\rho: U \times A \rightarrow V$ is an information function, such that for every element $x \in U$,

$\rho(x, a) \in V_a$ is the value of attribute a for element x.

The information system can also be viewed as an Information table, where each element $x \in U$ corresponds to a row, each attribute $a \in A$ corresponds to a column.

1.6 Equivalence Class

An equivalence class is a subset whose elements are related to each other by an equivalence relation. The equivalence classes of a set under some relation form a partition of that set (i.e. any two are either equal or disjoint and every element of the set is in some class). In this protocol, each node has the forward status by default, like flooding. However, the status of a node can be forward if the following sufficient condition called equivalence condition is met. Finding the equivalence nodes of source node neighbors from each equivalence classes, source node will forward the control packet to only one node to each equivalence class.

2 LITERATURE REVIEW

Lot of contributions was made to study and improve the performance of DSR in mobile ad hoc networks. The Dynamic Source Routing protocol allows mobile sources to discover the path towards any desired destination dynamically [2, 5].Every data packet includes complete routing information before it reaches the destination. Hence, all nodes that forward or listen in these packets may store routing information in route cache for future use. It can successfully find paths and forward packets in unidirectional link environments. It has a mechanism for on-demand route maintenance, so there are no periodic topology update packets. When link failures occur, only those nodes which forward packets through those links must receive proper routing advertisements.

In addition, DSR allows source nodes to receive and store more than one path towards a specific destination. Intermediate nodes have the opportunity to select another cached route as soon as they are informed about a link failure. When a source that desires to send data to a particular destination, first checks to whether it has a route in its cache for that destination. If it does, it will use that route by placing (in the data packet header) the sequence of hops that the packet must follow to reach the destination. If there is no such route stored in the local cache, then the source will initiate a new path discovery process, by broadcasting a Route Request to its neighborhood. Thereafter, every other node that receives this request message parses it to see if it is the intended destination.

The modified approach of DSR [6] protocol to reduce the broadcasting overhead during the route discovery process, each node takes part in forwarding Route Request (RREQ) packet. Each node except the intended destination forwards the Route Reply (RREP) packet to create the route. Though, these RREPs increase the number of multiple paths to reach destination, they increase the control packet load of the network. The modified approach is applied in basic DSR to reduce the redundant RREPs and the control packet overhead. Multicast of RREQ packet is preferable to broadcast which has been proposed in E-DSR.

In the literature several methods were presented to reduce the broadcasting in MANET's. In [6, 7] the path selection is based on finding cost evaluation. RREQ will use the cost to take the routing decision, but it is not used to eliminate the neighbor node in the literature to reduce broadcast variety of methods were introduced broadly they are categorized in to probability based; location based, neighbor information based and counter based methods.

3 PROPOSED WORK

During the route discovery process, each node takes part in forwarding Route Request (RREQ) packet [8, 9]. The use of an information system in mobile ad hoc routing was introduced and modified for better routing by using the equivalence class rather than the neighbor node information. An equivalence class condition is used to find the best neighbor node to forwarding RREQ.

In DSR, to discover a route from source to destination, source node broadcasts the RREQ packets to its neighbors (within in a transmission range). DSR protocol maintains a neighbor table to keep track of neighbors. Each node has X neighbors and there are Y hops from source to destination and R is the total no. of RREQ packets, then basic DSR requires

R = XY route request packets to be broadcasted.

When a node X receives a RREQ packet, it will perform following steps:

1. X finds out all of its neighbors from its neighbor table.
2. The equivalence condition is applied on the neighbors of X node it eliminates some nodes if they are equiva-

IJSER

ISSN 2229-5518

lent those node get the forwarding status again they apply the equivalence Condition on those neighbor nodes this process will continuous till the destination has to reach by the source node.

3. X forwards RREQ packets to the nodes found in step 2.

For example, a wireless network consists of 11 mobile nodes. Source S broadcasts RREQ packet to two nodes namely A and C as like DSR. In DSR when RREQ packet reaches node A and it broadcasting to its neighbor node B, E and F, but the Proposed DSR it sends RREQ packets to either E or F nodes because when A receives RREQ from S it appends its own address and the source route becomes [S, A]. Now A has 5 neighbors in its neighbor table S, C, B, E, and F. This overall procedure of DSR is shown in Figure 1. But since S is in source route, A won't send RREQ to S which reduces one packet overhead. Similarly, A reduces one more packet overhead. In a total, DSR sends 31 RREQ packets and in the same case Proposed DSR sends 2 RREQ packets. This overall procedure of DSR is shown in Figure 2. That's send either E or F node. If that two node has link break then take another forwarding node to sending RREQ. As a result, Proposed-DSR reduces control packet overhead to a great extent. This overall procedure of DSR is shown in Fig 1.

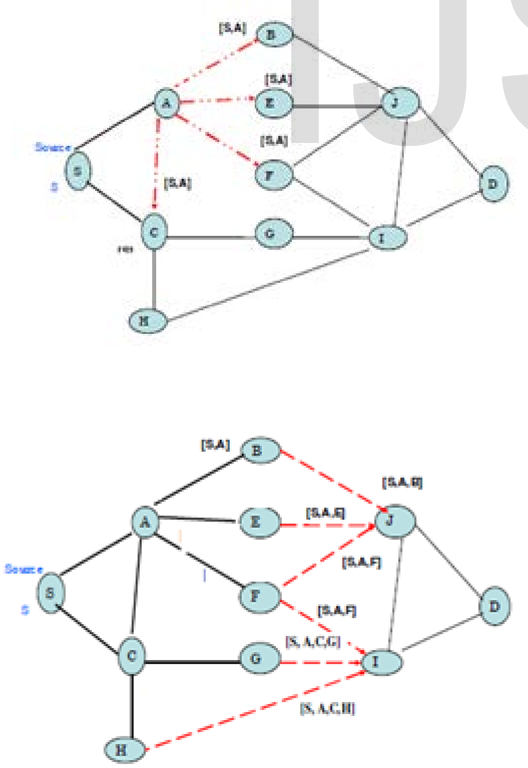

Fig. 1. DSR sends RREQ in More Neighbor node.

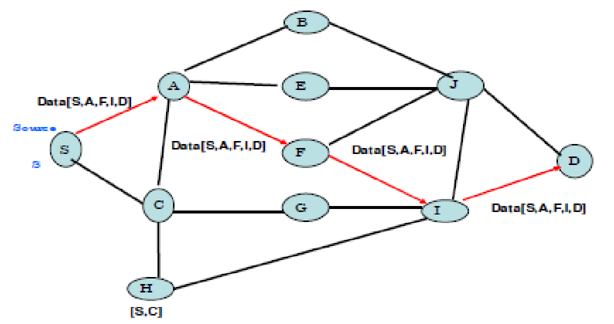

Fig. 2. Proposed DSR sends to single neighbor node.

In the Fig 2 node A neighbors are C, B, E,F and G forwarding status is depend on equivalence class construction.

TABLE 1
NODE A NEIGHBOR NODE CHARACTERISTICS

Node	Velocity	pause time	traffic	Relative distanceΔRt	Battery power
E	30	10	1000	-10	100
B	40	20	1500	-20	200
C	50	30	500	30	500
F	10	40	2000	-40	100
G	50	25	1600	40	300

In the above table 1, we considered node characteristic values are velocity, pause time, traffic, battery power and relative distance. The last one relative distance is calculated according to the following way.

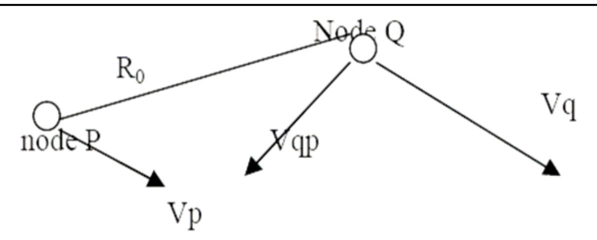

Fig. 3. Magnetization Relative Distance between Two nodes.

Node P velocity is Vp and Node Q velocity is Vq initial distance between P and Q is R after Δt sec the distance between P and Q we call as Relative distance between P and Q.

Fig 3 shows a case that two mobile nodes are moving respectively in different speed and different directions. Let Vp and Vq denote the velocity of node p and node

IJSER

q respectively, Vqp = Vq − Vp is the relative speed between p and q. In order to simply the analysis, we assume Vp and Vq are invariant in a small time slot Δt.

Assume after a slot Δt , the distance between p and q changes to Rt. According to Fig 3 , Rt can be concluded.

$$R_t^{\,2} = R_0 + (V_{qp}.\,\Delta t)^2 - 2\,R_0\;V_{qp}\,\Delta t \cos\delta$$

Ro and δ can be derived from the route discovery packets between each neighboring node, and Vqp can be computed by Vq and Vp. If ΔR < 0 , it means that the two neighboring nodes are moving closely within Δt , so we consider the link between the two nodes is stable link with in Δt.

The node characteristic values are converted in to rough set node information as shown in the table 2 according to the following if then else rules.

TABLE 2
ROUGH SET NODE INFORMATION SYSTEM

Node	Velocity	Pause time	traffic	Relative Distance ΔRt	Battery power
E	0	0	1	1	1
B	0	1	0	0	1
C	0	1	1	0	1
F	1	1	0	1	1
G	0	1	0	0	1

E = { (i , j) / vprb(i) = vprb(j) } Where a, b, d and e are the characteristics of neighbor node. Here v is velocity, p is pause time, r is relative distance and b is battery power of a node. According to the above definition node E and F are equivalent nodes. So node A gets next neighbor node status either E or F node.

The source node and in any intermediate forwarding node, the above equivalence condition system is used to find the best next neighbor node to send RREQ. When the next vast neighbor node to send RREQ is found from the information table, that node is used by the entries of route path to reach the destination.

4 SIMULATION RESULTS

In Proposed DSR, the basic problem of DSR has been improved by reducing Route Request overhead which has been shown by using the extended version of ns2 (network simulator version 2) [10]. In the simulation, it has been shown that the performance of Proposed DSR is much better than DSR and E-DSR.

Here it is assumed that, the ad-hoc network consists of 100 wireless nodes, moving about over a 1500 X 1000 flat space for 200 seconds of simulated time. In order to enable direct, fair comparisons between the proposed DSR, DSR and the E-DSR, it was critical to challenge the protocols with identical loads and environmental conditions. Each run of the simulator accepts a scenario file as input that describes the exact motion of each node and the exact sequence of packets originated by each node, together with the exact time at which each change occurs in motion or packet origination. Since each protocol was changed in an identical fashion, the performance of these protocols can directly be compared.

4.1 Route Request Packet Overhead

Proposed DSR reduces Route Request overhead of packets. Fig 4 can be concluded that, as the number of nodes increases in a network, number of packet overhead is reduced in Proposed DSR than that of DSR and E-DSR.

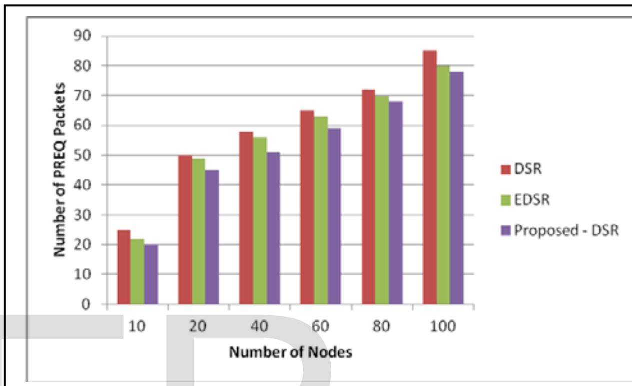

Fig. 4. Comparison of Proposed- DSR, DSR and E-DSR in case of reducing RREQ packets.

4.2 If Control Packet Overhead

In DSR, broadcasting of each Route request packet involves several consecutive control packets like RTR, MAC. So, reduction of Route Request packets in Proposed DSR also reduces control packet overhead (shown in Fig 5).

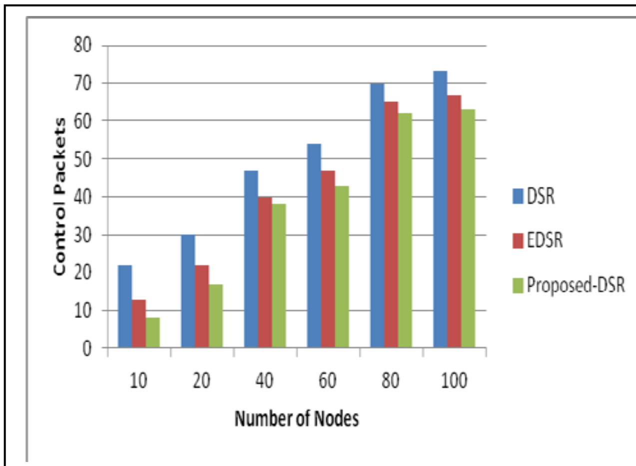

Fig. 5. Comparison of Proposed- DSR, DSR and E-DSR in case of control packets.

4.3 Data Delivery Ratio

Delivery ratio is a measure of efficiency. In Proposed DSR, since the number of control packet is reduced, number of sent packet is also reduced. So there is less traffic in the network and delivery ratio is high. So it can be said that, Proposed DSR is more efficient than E-DSR and DSR. Fig 6 is shown the improvement can be observed.

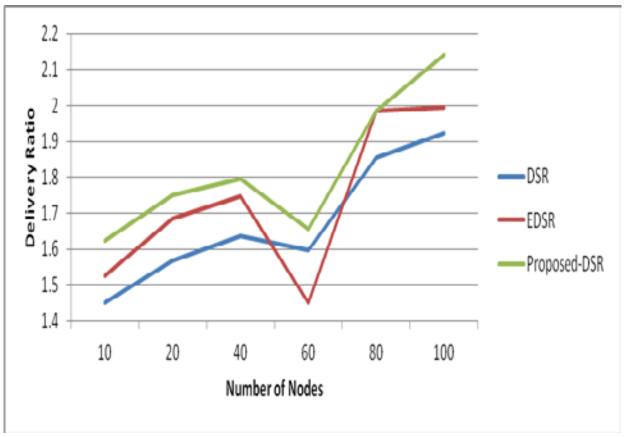

Fig. 6. Comparison of Proposed- DSR, DSR and E-DSR in case of delivery packets ratio.

4.4 Throughput

End-to-end data throughput is measured the sum of the data packets generated by every source, counted by k bit/s. Proposed DSR is more efficient than E-DSR and DSR. From Fig 7, this improvement can be observed

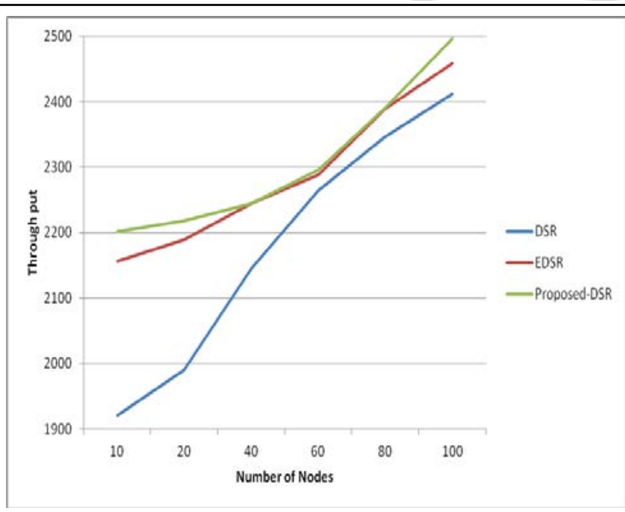

Fig. 7. Comparison of Proposed- DSR, DSR and E-DSR in case of Throughput.

A performance comparison of Proposed DSR with DSR and E-DSR routing protocols for mobile Ad-hoc networks are presented as a Number of nodes. Figure 4 and 5 are the comparison results in Route Request packet overhead and Control packet overhead between Proposed-DSR and DSR E-DSR. Performance of these routing protocols is evaluated with respect to above two performance metrics such as packet delivery ratio, and throughput. According to the simulation results, Proposed DSR shows best performance than DSR and E-DSR in terms of packet delivery ratio, and throughput as a function of Number of nodes

5 Conclusion

This paper has proposed modified DSR algorithm Reducing Route Request packet overhead DSR. We have presented an efficient flooding. We showed that our proposed forwarding RREQ-node selection algorithm results in fewer broadcasts in the network. It framed the rules to convert the given node information system based on that we will find the forwarding status of node. Performance of Proposed DSR is elevated in respect of some simulation metrics such as Route Request and control packet overhead, and packet delivery ratio. Proposed DSR algorithm is to find the best next neighbor and it will reduce the RREQ overhead problems. It is found that the performance of the Proposed DSR will improve in all four metrics than DSR and E-DSR. It was shown in the graphs. It was seen that Proposed-DSR performed better than DSR and E-DSR. The Proposed-DSR adapts quickly to routing changes by reduction of sending route request packet when the size of the wireless network is large enough.

IJSER

Acknowledgments

The first author acknowledge the UGC to support this work under UGC Minor Research Project F.No. 41-1355/2012 (SR).

References

[1] Charles E. Perkins. Ad Hoc Networking. Addison Wesley, 2001

[2] Elizabeth, Royer, Chai-Keong, Toh: "A Review of Current Routing Protocols for Ad Hoc Mobile WirelessNetworks," IEEE Personal Communications, April 1999.

[3] David B.Johnson and David A. Maltz. Dynamic source routing in ad hoc wireless networks. In Imielinski and Korth, editors, Mobile Computing, volume 353. Kluwer Academic Publishers, 1996

[4] Z. Pawlak. Rough sets. International Journal of Computer and Information Sciences, 11(5):341– 356, 1982.

[5] David B.Johnson, David A.Maltz,Yih Chun Hu, (July, 2004) "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks(DSR)", Internet Draft, draft-ietf-Manet-dsr-10.txt.

[6] Sharmin Sultana, Salma Begum, Nazma Tara, Ahsan Raja Chowdhury "Enhanced-DSR: A New Approach to Improve Performance of DSR Algorithm", International Journal of Computer Science and Information Technology, Volume 2, Number 2, April 2010

[7] Xu ZHANG , Sheng CHENG, Mei-yu FENG and Wei Ding,"Fuzzy Logic Qos Dynamic Source Routing for Mobile Ad Hoc Networks",In the proc of IEEE conf 2004.

[8] Shivanajay M. Dipti Srinivasan, Chen Khong Tham, Althanasios Vasilakos,"Evolutionary Fuzzy Multi-Objective Routing For Wireless Mobile Ad Hoc Netoworks". In the proc of IEEE conf 2004.

[9] Jyoti Raju, J.J.Garcia Luna Aceves, (October 2001) "Scenario based comparison of source_tracing and Dynamic Source Routing protocols for Ad Hoc Networks", ACM SIGCOMM Computer Communication Review Vol. 31, No.5.

ISSN 2229-5518

[10] Charles E. Perkins, Elizabeth M. Royer, Samir R. Das and Mahesh K. Marina, (February 2001) "Performance comparison of two on-demand routing protocols for ad hoc networks", IEEE Personal Communication.

[11] USC/Information Sciences Institute, Network Simulator, at http://www.isi.edu /nsnam/ns/.

[12] W.Peng and X.C.Lu," On the Reduction of Broadcast Redundancy in Mobile Ad Hoc Networking and Computing", MOBIHOC, pp. 129-130, Aug.2000.

[13] Wei Lou and Jie Wu ," On Reducing Broadcast Redundancy in Ad Hoc Wireless Netoworks", IEEE Transaction on Mobile Computing, Vol 1 No 2 , April-June 2002.

[14] W Peng and X C Lu," On the Reduction of Broadcast Redundancy in Mobile Ad Hoc Networking and Computing "Mobihoc , pp, 129-130 Aug 2000.

IJSER