

An Efficient Proactive Source Routing Protocol for Controlling the Overhead in Mobile Ad-Hoc Networks

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Abstract

The paramount objective of this paper is to reduce the communication overhead and to improve the Packet delivery Ratio among Mobile nodes using Efficient Proactive Source Routing Protocol (EPSR). In Previous Method, there is transmission link breakage which leads to overhead. In EPSR, the mobile nodes are chosen with help of signal strength instead of idle nodes. This reduces the transmission link breakage and improves the performance. The Multipath Route Discover Algorithm using OLSR and Loop Control using DSDV reduces the communication overhead and improves the Packet Delivery Ratio. To examine the methodology, various mobile nodes are analyzed using the proposed techniques. It shows that our method improves performance of Mobile Adhoc Networks Communication by reducing overhead and improving the Packet Delivery Ratio using the Ns2 simulation graph.

Keywords: Loop Control, Mobile Ad Hoc Network, Multipath Route Discover Algorithm, Proactive Source Routing Protocol

1. Introduction

The Mobile Adhoc Network (MANET) is primarily called as Multihop Wireless Network^{1,2}. It is an independent and self- configuring mobile nodes i.e. autonomous network connected wirelessly. Each node in MANET considered as hosts and router to transmit the data packet³. The transmission takes places in random way. Mobility between every nodes changes disparately in every period of time. Therefore enormous changes will affect the network topology. The present challenge of adhoc network is due to the transmission power. When low power occurs, it limits the number of nodes in network, thus increases the changes in network due to its mobility⁴. A concept called radio transmission range is created to overcome

the problem faced during out of range that is outside the network⁵⁻⁸. During out of range all the nodes in the network rely on one another to transmit the data packet⁹. This kind of network deliberately needs certain protocol for routing the packet from source to destination in an effective way. Due to its independent nature, MANETS are used in military applications, Battle Field and many Disaster relief applications.

1.1 MANETs Routing

Routing the data packet using protocol can be done with certain procedures. At first it has to discover the neighbor node, whether it is active or not. Therefore it will forward the HELLO message packet called Route Request (RREQ) to all the nodes in the network and Route Reply (RREP)

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will acknowledge source node when nodes are idle¹⁰. The HELLO message RREQ can increase the network communication overhead. To avoid that problem, while broadcasting RREQ itself I will forward with its broadcast ID and sequence number¹¹. It checks this two ID, if it's already present then that request will be discarded by any nodes. Therefore overhead can be reduced¹². A few routing protocols falls under table- driven protocol called proactive routing protocol, On-demand driven called Reactive Routing Protocol and Event- driven called Hybrid Routing Protocol¹².

1.2 Proactive Routing Protocol

The proposed work deals with proactive routing protocol. Proactive is referred to as keeping the up-to-date information of routing path in each mobile node of the MANETs. This protocol mainly used to maintain the topological information of the network and update it periodically to every node in the network¹³⁻¹⁶, when it encounters any changes in the topological structure. The topology information will be maintained in each and every node using the routing table. Hence this method is called "Table-driven"^{16,17}. If the number of nodes increases in the network, which reflects the network. Hence more overhead will occur while communicating that can be reduced by various routing protocols namely; Proactive Source Routing protocol (PSR)², Optimized Link State Routing Protocol (OLSR)¹⁸, Destination Sequence Distance Vector Routing Protocol (DSDV)¹⁹, and so on.

2. Materials and Methods

2.1 Proposed Design for Efficient Proactive Routing Protocol

The proposed protocol uses the tree structure to reduce the communication overhead. At first the tree structure is flooded among all the nodes in network. Once a neighbor receives updated information it constructs Depth First Spanning Tree (DFST) itself and obtains the best route to transfer the data from source to destination. It maintains a Spanning Tree among all dedicated nodes to dispense susceptible data conveyance amenity. Nodes simultaneously disperse tree structure data to the best of its apprehension. Based on the information accumulated from its adjoining nodes, a node can inflate its horizon of apprehension. Then these apprehensions (knowledge) can trade- off among all the adjoining nodes in succeeding

iteration. At Inception, the source node acquainted with existence of neighbor by observing to their HELLO MESSAGING Packet⁶. The communication overhead can be reduced, because rooted tree is transformed into binary tree of equal size. In each cycle, the nodes disperse update message to delineate the changes in locally stored Depth first spanning tree. Once message received it removes the edges and makes use of it to reconstruct the new DFST. The unreachable nodes also be trimmed off, then it repairs the route from source to destination using the copy of DFST in every nodes in the network. The graph G with number of nodes which includes source S and destination D (i.e.) $G(s, d, v, n)$, Where s- source, d- destination, v- vertex and n- number of nodes⁶.

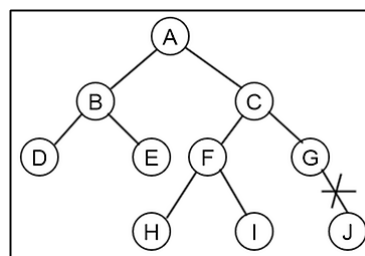


Figure 1. Tree Structure.

At first the source node A senses only its subsistence and update itself as G (A) then it will establish the tree structure with the information like source address, path and its destination address. Once the tree created then it will include the hello message packet which is 1 bit before the update tree structure is been broadcasted. In Figure 1: The node that is not forming binary tree will be discarded, since node J did not satisfy the condition hence it will be terminated.

2.2 Route Discovery

The route will be discovered using the multipath route discover algorithm, which helps to discover multiple path, in case of failure in one path it will take another path to reach the destination on time so that only fraction of delay will be encountered without packet loss^{20,21}. Once route is been discovered the update message N (A) is sent to all the nodes per cycle of period. Then the source node will select the neighbor node which is having equal or lesser threshold value when compared to its node²¹. After selecting the neighbor node it then source node broadcasts the tree to its neighbor node at the peroration of the period. The broadcasting message in the form:

$$G'(A) \leftarrow A_a \cup \sum N(A). (R_i - A)$$

$G'(A)$ is tree structure of recent update message to be broadcasted at the end of period. $N(A)$ is the updated message of all nodes in the graph which is concatenated, R_i denotes the recent iteration received in form of tree and it will subtract the unbalanced node from the tree structure and then node A will establish the new tree structure with recently data from to its valid neighbor node. The DFST updates periodically within the update interval so that the node can easily identify the new route and update it instantly.

2.3 Path Repair

The graph $G(s, d, n)$ where s- source, d- destination and n- number of nodes after identifying the path, packets are transmitted in that estimated shortest path, in case there is a chance to come across a link breakage in that network. To avoid that the path recovery is used. The shortest path to reach destination estimated using the OLSR protocol²¹. Figure 2 depicts path repair procedure. At the time of packet transmission, the primary route will be estimated as $s \rightarrow m \rightarrow t \rightarrow u \rightarrow d$, and $s \rightarrow p \rightarrow q \rightarrow w \rightarrow d$. Each node forwards the packet whether or not neighbor nodes are intact. In such cases if a neighbor w is out of range, then packets transmitted through that path will be dropped due to link failure and cannot detect the loss instantly. Therefore more packets will be dropped and overhead occurs. To overcome that, path recovery scheme is incorporated to every node so that each node will check whether the receiving node is intact, if still in contact will forward, else the previous node q will re-estimate the path to reach the destination, then the incoming packet data will be transmitted via the new route. It reduces the delay, because it detects only the topology information of local nodes. Therefore packet delivery ratio is increased.

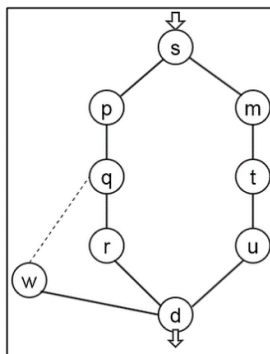


Figure 2. Path Repair.

2.4 Loop Detection

The path $v \rightarrow u \rightarrow w$ will create the loop in the network to avoid the path repair scheme is used in node v then the new route is estimated from present node v to destination. It requires very less memory overhead based on multipath recover algorithm. There is a case where no suitable path exists, the packet will be discarded. Node v creates a new route as no connection between $v \rightarrow w$ due to link failure. The reduction of loops in the network will efficiently reduce the congestion and delay.

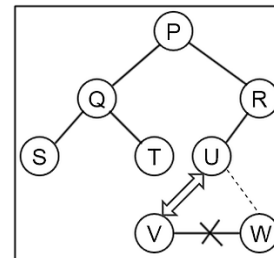


Figure 3. Loop Detection.

2.5 Route Update

The route update will be done using the method called hop metrics^{21,22}. The metrics are evaluated at each and every node when an update is arrived. There is some mathematical calculation for updating the route in routing table of each node. If there is more changes in hop will enormously increase mobility. This change will influence all the nodes in the network. Hence there need a periodic update before packet is been exchanged between the nodes. It can be estimated using:

$$\text{Route Update} = \sum_{i=1}^n \left(\frac{h_N - h_p}{T_{N_p} - T_{P_p}} \right) / \text{Nodes}$$

Where, h_N and h_p determines the new metrics between current or previous node and source node. T_{N_p} and T_{P_p} determine the last and previous updates periods respectively. This estimation is mandatory because including new node or updating nodes address does not have any link with topology change due to mobility. The full update for network done only calculated metric is bigger than the defined threshold value. The threshold value estimated empirically.

2.5.1 Algorithm for Multipath Route Discover

Multipath Route (s,d,G,N)
 $C' \leftarrow c$
 $G' \leftarrow G$

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For u ← 1 to N do
Treei ← Dijkstra (G', S)
Pathi ← Path estimate (Ti, D)
For each arc a and vertex v in A and V
Ta ← (1 - Rl). (Ta)
Rl = ((links lifemax - links lifemin)/links life timeavg)
Tv ← (1 - Rn). (Tv)
Rn = ((nodes lifemax - nodes lifemin)/nodes life timeavg)
End for
If a (A) ← Pathi
C'x+1 ← Cr (C' (a))
Else if V (a) ← Pathi
C'x+1 ← Ca (C' (a))
End if
End for
G'x+1 ← (V, A, C'x+1)
Return (Pi) where i= 1, 2, to n)
End
    
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3. Results and Discussions

3.1 Experiment Settings

The performance of Efficient Proactive Source Routing protocol (EPSR) is estimated by using the Network Simulator NS-2. The results is evaluated based on the performance analysis of EPSR it shows only less of overhead and an improvement in the packet delivery ratio due to the strong transmission link constructed using the signal strength of nodes. The simulation of the EPSR was estimated in NS2 for 50 /mobile Nodes having wireless link and with Omni-directional antenna. The Mobility models are chosen for simulating the nodes with network dimension area 1000 x 1000 m². The various parameters used for simulating EPSR protocol are given below.

Table 1. Simulation Parameters

Parameters	Values
Number of nodes	10 ³
Environment Size	1000x1000
Simulator	NS-2
Packet Traffic	CBR
Speed	0-30 m/s
Simulation Time	10 sec
Pause Time	Dynamic
Mobility Model	Random Way Point
Connection and antenna Type	UDP and Omni-Directional

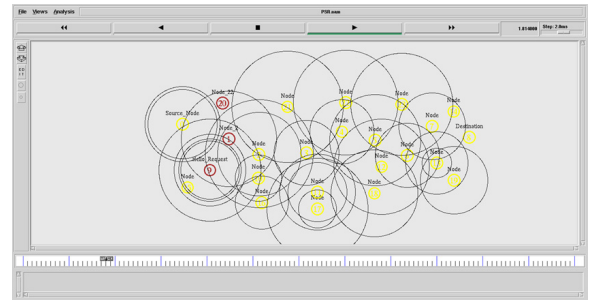


Figure 4. Simulation Scenario.

In this scenario the nodes are detected using the HELLO message broadcasting. Those are in red color are detected and it's idle to receive the data packet from the source node. Inside each node there is a number which indicates the signal strength of that node. Once all nodes are detected it will enable the multipath route discover algorithm to discover the path which is optimized to reach the destination.

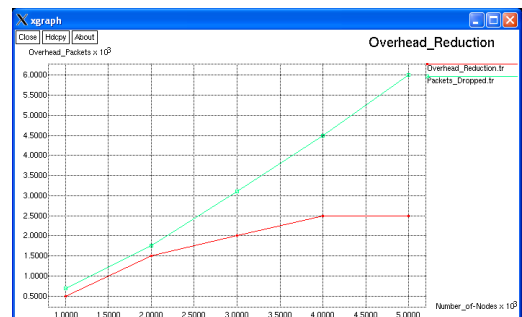


Figure 5. Overhead vs Number of Nodes.

Figure 5 describe about the Overhead of the Proposed EPSR protocol. This evaluation is carried out with 10³ No. of Nodes and overhead packet with size 10³ in x-axis and y- axis. This estimation shows Overhead Reduction is high and less packet dropped ratio due to the Hello scheme with signal strength analysis respectively.

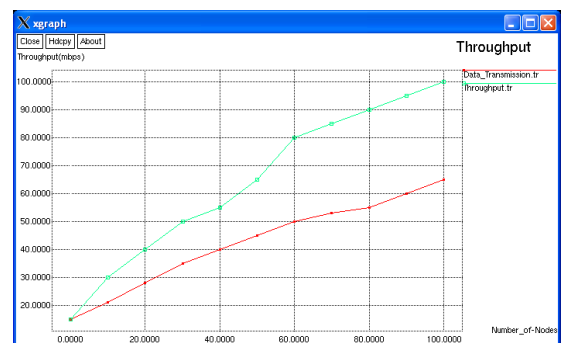


Figure 6. Throughput vs Number of Nodes.

Figure 6 describes about the Throughput of EPSR protocol. This evaluation is carried out with 10^3 No. of Nodes and Throughput in mbps in x-axis and y- axis. This result shows high throughput of sending packets and it outperforms the underlying protocols. The loop detection helps to identify the infinity loops and discards it which further increases the throughput

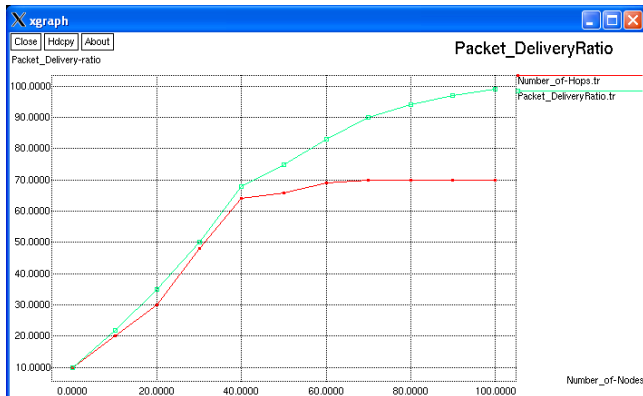


Figure 7. Packet Delivery Ratio vs Number of Nodes.

Figure 7 depicts the Packet Delivery Ratio (PDR) of proposed EPSR protocol. This evaluation is carried out with 10^3 No. of Nodes and Packet Delivery Ratio in x-axis and y- axis. This estimation shows remarkably high PDR. The EPSR helps in Path recovery, route update and throughput of receiver side packet is exceptionally better.

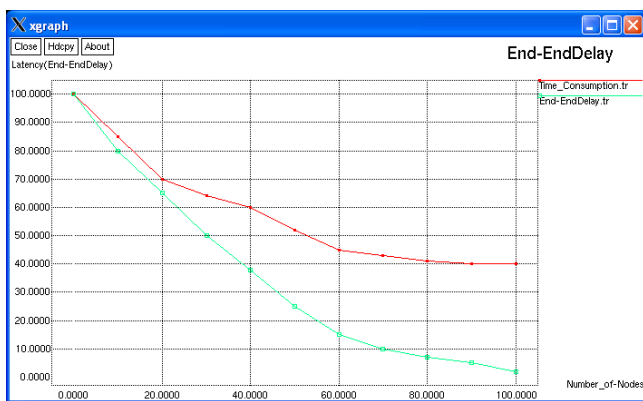


Figure 8. End- to- End Delay vs Number of Nodes.

Figure 8 depicts End- to- End Delay for proposed approach. This evaluation is carried out with 10^3 No. of Nodes and End- to- End Delay with Latency in x-axis and y- axis. This estimation shows decreasing down time when it encounters the transmission of packet from source to destination in estimated optimized path. The

End- to- End Delay is reduced due to the Healing of Route and fraction Rerouting using the Multi path Route Discover algorithm.

4. Conclusion

In this paper, a brand new efficient Protocol scheme called Efficient Proactive Source Routing Protocol is proposed in order to reduce the Overhead to a fraction amount and improve the low Packet Delivery Ratio with high mobility Nodes. We elucidated a new multipath Route Discover algorithm for controlling the overhead in case of transmission link breakage. It is shown that this algorithm can work well during frequent topological changes in the network. The loop detection scheme used to avoid the infinity loops and discards the stale routing information if any. The other scheme helped to improve the Packet Delivery Ratio is Interval Scheme and Route Update scheme which choose only the signal strengthen node to pass through the packet and also identify the optimized path to deliver the packet to its destination. This scheme improved the Packet Delivery Ratio. Since the communication is dropped due to the transmission link breakage. The main attribute that causes the major packet drop is due to enormous information dumped in the nodes to transmit the packet. To reduce this disadvantage, the Binary tree structure is maintained to optimize the information to a very small one. This helped to reduce the pause time and also transmission time thereby reduces the End-to-End Delay and also increases the Throughput. On the basis of simulated result, it is concluded the New Efficient Proactive Source Routing Protocol (EPSR) performs well in Overhead Reduction and Improving the Packet Delivery Ratio.

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