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ROAM: Routing Overhead Aware Mechanism to Reduce Number of Routing Entries in Mobile Ad-hoc Networks

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ABSTRACT

Mobile Ad-hoc Networks (MANETs) comprise of more number of mobile nodes connected through wireless links to form a temporary communication for sharing information among the users. Since nodes are having mobility nature, it is free to move anywhere. If mobility of nodes is high and its link establishment is irregular. It often leads to frequent link failure and route retransmissions. In proactive approach, sometimes link failure leads to a heavy routing overhead during high mobility. And also maintaining all the nodes of information is a routing overhead in the routing table. In order to overcome the issue, the Routing Overhead Aware Mechanism (ROAM) is proposed to reduce number of routing entries in routing table. The cost table is also introduced along with total cost to find out the maximum number of flow occurs in a node. The ultimate aim of this paper is to enhance performance of the network. The results and findings show that the reduction of routing entries leads to significant reduction in less routing overhead. It computes the path very quickly with minimum computations.

Keywords: Link Failure, Routing Overhead, Minimum Computations and Mobility.

1. INTRODUCTION

In MANETs, ad-hoc routing protocols are developed to support discovering route and maintenance functions for each mobile node in the network environment to communicate with other nodes. Generally routing protocols have been functioning in three ways: Proactive, Reactive and Hybrid. In proactive approach, each node intimates its routing information to all of its neighbours in the network even if there is no change in network topology. As it store all nodes, information in routing table and maintaining these information up-to-date increases the routing overhead. Destination Sequenced Distance Vector (DSDV) protocol, Wireless Routing Protocol (WRP) and Fisheye State Routing (FSR) protocol are the examples of proactive protocols. In other words, nodes often change their location within network. So, already computed route will be generated again in the routing table which leads to unnecessary routing overhead. Reducing routing overhead is one of the important challenges in routing protocols of MANETs. Once routing overhead increases, it wastes the network resources such as bandwidth, battery power, etc., In Reactive approach, each and every node does network identification and maintains the route on-demand basis. It broadcasts control packets during route discovery time and bandwidth is used for carrying the information from source to destination.

This protocol requires less routing information but the disadvantages are, it produces huge control packets during route discovery process and frequent link failure leads MANETs. It leads to high delay and cost of routing

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overhead is increased. Ad-hoc On Demand distance Vector (AODV) and Dynamic Source Routing (DSR) are the examples of Reactive protocols. Hybrid protocol combines both features of Proactive and Reactive. It maintains routing table on-demand basis or periodically exchanging route information based on the network condition. Associativity Based Routing (ABR) and Location Aided Routing (LAR) are the examples of hybrid protocols. Although these protocols work well, it often leads to heavy routing overhead. Hence, it affects the data transmission process very badly and also it degrades the performance of the network. In order to reduce the routing overhead, the paper proposes a mechanism called ROAM to reduce the routing entries in routing table.

The rest of this paper is organized as follows. Section 2 presents the review of literature in MANETs environment. Section 3 proposes routing overhead aware mechanism to reduce routing overhead. Section 4 shows results and discussion on graph method. Section 5 focuses on conclusion.

2. RELATED WORKS

Recent research has been focusing on to save battery power of the nodes, whereas the issue of reducing routing overhead also leads to performance degradation. It is increasing the attention among researchers to address this issue for increasing performance of the network. This section presents literature study to reduce routing overhead for improving the performance of network.

Generally, routing overhead occurs while sending more number of control packets such as Route Request (RREQ), Route Reply (RREP) and HELLO messages. In other ways, routing overhead occurs when it changes the topology very frequently [1].MANETs used probabilistic rebroadcast mechanism for reducing routing overhead during routing process. And also it introduced rebroadcast delay scheme to identify the neighbor coverage knowledge which helped for finding precise additional coverage ratio and rebroadcast order. Connectivity factor also provides node density adaptation to improve routing performance and decrease routing overhead by decreasing the number of retransmission [2].

Neighbor scope based probabilistic rebroadcast convention scheme is developed for reducing overhead in MANETs. By joining the additional scope proportion and availability element, it acquired more precise information by detecting neighbor. Rebroadcast convention scheme evaluate the advantages of both neighbor scope information and probabilistic instrument through which it reduces the retransmissions in order to reduce routing overhead [3]. Neighbor Coverage based Probabilistic Routing Protocol (NCPR) is enhanced by minimizing neighbor list information and minimum control packets in routing table. RREQ and HELLO messages play a vital role for discovering route. The neighbor table complexity is reduced by adding new two fields namely num_neigh and node id in the default RREQ format [4].

The modified rebroadcast algorithm in MANETs is proposed to reduce routing overhead. NCPR protocol increases packet delivery ratio and reduce the delay of packets. It reduces the routing overhead by minimizing Route Error (RERR).This is achieved by setting threshold value which helps to predict the link failure along with active route and perform local route repair for improving performance of the network [5]. Probabilistic rebroadcast protocol scheme is proposed based on neighbor coverage for reducing routing overhead in MANETs. This scheme consists of coverage ratio and connectivity factor for calculating rebroadcast delay which is used to find out forwarding order of packets and make use of neighbor coverage information in effective manner. Simulation result shows that rebroadcast protocol produces less traffic than flooding based schemes [6].

Once data packets are sent, it conveys the routing information to each and every node to estimate the hop counts between source and destination and stored in primary table. If any new information is found, the routing table entry is moved from primary to secondary table. The new routing information is immediately replaced by routing entries in the primary table. As a result it reduces in lower delay and control overhead enhanced the performance in the ad hoc network [7]. Each node keeps on updating about alternate paths to send and receive packets. The sender can avail the alternate path instead of dropping the packet where two intermediate nodes are broken. During link failure or absence of alternate paths, the control packets were used to check for alternate paths. If any information is found, then the node which detects the link failure and sends RERR packet to the node that has the alternate paths and finally the packets is sent to destination [8].

Each node forwards and stores the packets in routing table by using reliable broadcasting algorithm and efficient forward node selection mechanism. After receiving new broadcast packets, the sender node wait for certain interval time for rebroadcasting packets from its forwarding nodes. When sender node fails to detect all its forwarding nodes during retransmission time, it makes sure that transmission failure has occurred for that transmission. Results show that it increases in packet delivery ratio and less control overhead [9].New approach is developed to minimize flooding overhead to forward the messages to its neighbors depend on probability of detecting the destination nodes. This approach enhances the AODV protocol during route establishment process. The main intention of this scheme is to reduce latency and routing overhead. This method considers probability of success to connect to the destination. The probability depends on previous behaviour of a node to get the destination through outgoing links. Connectivity index scheme was used to calculate this probability of selecting neighbor node to initiate RREQ [10].

Seamless data transfer is not possible, since all the nodes are changing dynamically. The refined hamming distance (REHDIS) considers two important parameters such as refined hamming distance and delay. It selects the best optimum path from various paths. It attempts to transfer the data quickly. Ultimately, it enhances the Quality of Service in MANET. Though REHDIS has merits, it also has weakness like maintenance of tables [11]. There are more number of algorithms exists to minimize the unnecessary route requests for maximum utilization of available bandwidth. The MIDURR technique is proposed to minimize the duplication of route requests in MANET [12]. Some routing algorithms are used to transfer the data via multiple paths to reduce end-to-end delay between source and destination. Continuous data transfer is not possible since all the nodes are changing dynamically. It considers two important parameters such as number of neighbor node calculation and delay. It selects the best optimum path from multiple paths. It increases the speed of the data transfer in MANET as the path selected by the technique has minimum neighbors [13].

3. ROAM: A PROPOSED ALGORITHM

In MANET, the network topology changes frequently cause routing overhead due to dissemination of routing information to its neighbors periodically. In proactive approach during path establishment, routing protocols produce a large number of routing information throughout the network. The proposed routing aware mechanism is used to reduce routing entries in routing table based on total cost and delay parameter. The following steps elaborate ROAM.

//* Routing Overhead Aware Mechanism for Reducing Routing Entries in MANETs ***/**

Begin

1. **/***Determine the path from Source to Destination to route data packets*/

    If (node is Source) *Then*

        Broadcast RREQ to its neighbors

    Else (Rebroadcast RREQ)

   Likewise find all possible paths from Source to Destination

2. **/***Compute cost among the available nodes***/**

    If (nodes are within communication range) *Then*

        Set as ‘1’ in cost table

    Else (Set as ‘0’ in cost table) *Then*

3. **/*** Selection of Nodes with maximum cost***/**

   If (Nodes with maximum cost) *Then*

   Select all the paths which have maximum cost

   Else (Repeat Step 3)

4. Calculate the delay of all paths that are identified in Step 3

5. **/***Selection of path ***/**

   If (Path is minimum delay) *Then*

   Select the best path

   Else (Alternate path is selected)

6. **/*** Select path from routing table***/**

   If (Delay and hop count are sane for more than one path) *Then*

   Select the path which is calculated first in the routing table

   Else (Repeat step 5)

End

Certainly, forwarding data packets via path that has maximum nodes provide less routing overhead.

4. RESULTS AND FINDINGS

The ROAM is proposed to reduce number of routing entries in routing table among the calculated paths. It is described by considering the network topology as shown in Figure 1. There are 8 nodes considered in the network scenario. They are A, B, C, D, E, F, G and H. The number on edges denotes delay in seconds. In which, Source node is 'A' and Destination node is 'H' and other nodes are considered as intermediate nodes.

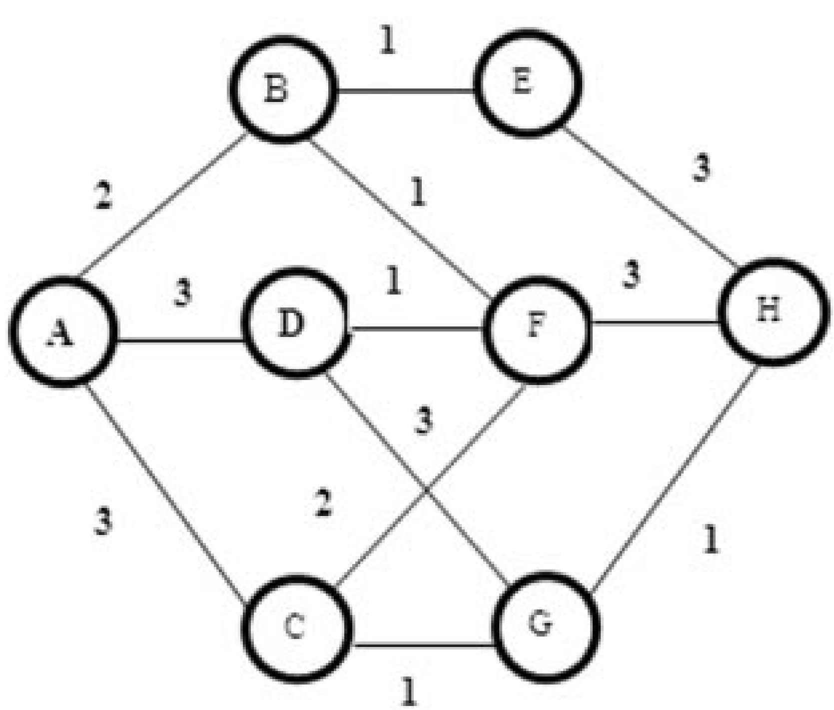

Figure 1: MANET Topology with Delay Parameter

4.1. Network Scenario

Total Cost can be calculated as sum of all '1s' in the cost table. In Table 1, the maximum Total Cost node 'F' is identified since it has maximum number of '1s' (i.e., 1 + 1 + 1 + 1 = 4). After identifying the cost for every path, select all the paths that have a node with maximum cost. In Table 1 , the maximum weighted node 'F' is identified as it has maximum number of '1' and finds all the paths which pass through node 'F'.

ROAM cost table is calculated based on Step 2.

Table 1
ROAM Cost Table for All Nodes

	A	B	C	D	E	F	G	H	Total Cost
A	**0**	1	1	1	0	0	0	0	3
B	1	**0**	0	0	1	1	0	0	3
C	1	0	**0**	0	0	1	1	0	3
D	1	0	0	**0**	0	1	1	0	3
E	0	1	0	0	**0**	0	0	1	2
F	0	1	1	1	0	0	0	1	4
G	0	0	1	1	0	0	**0**	1	3
H	0	0	0	0	1	1	1	**0**	3

There are eight paths which pass through node 'F'. First path is A→B→F→H, second path is A→D→F→H and third path is A→C→F→H. Similarly, the remaining five paths are calculated and stored in routing table. The identified path(s) is/are prioritized based on delay parameter. The path with first priority is A→B→F→H, second priority is A→D→F→H and the third priority is A→C→F→H. Likewise, all the paths are ranked according to delay parameter. The remaining paths A→B→E→H, A→C→G→H and A→D→G→H are not computed as it does not passes through node 'F'. Thus, it reduces routing entries and also it yields less overhead in the routing table. Table 2 shows the number of available paths before assigning priority with delay parameter.

Table 2
Available Path(s) With Delay in Existing Techniques

No. of Path (s) Available	*Routing Path(s)*	*No. of Hops*	*Delay(in Secs)*
1	A→B→E→H	3	6
2	A→B→F→H	3	6
3	A→C→G→H	3	5
4	A→C→F→H	3	8
5	A→D→F→H	3	7
6	A→D→G→H	3	8
7	A→B→F→C→G→H	5	7
8	A→D→F→B→E→H	5	9
9	A→D→F→C→G→H	5	8
10	A→C→F→B→E→H	5	10
11	A→C→G→D→F→B→E→H	7	12

Table 3
Available Path(s) After Prioritized With Hop Count and Delay

Priority Order	*Routing Path(s)*	*No. of Hops*	*Delay (in Secs.)*
1	A→B→F→H	3	6
2	A→C→F→H	3	8
3	A→D→F→H	3	7
4	A→B→F→C→G→H	5	7
5	A→D→F→B→E→H	5	9
6	A→D→F→C→G→H	5	8
7	A→C→F→B→E→H	5	10
8	A→C→G→D→F→B→E→H	7	12

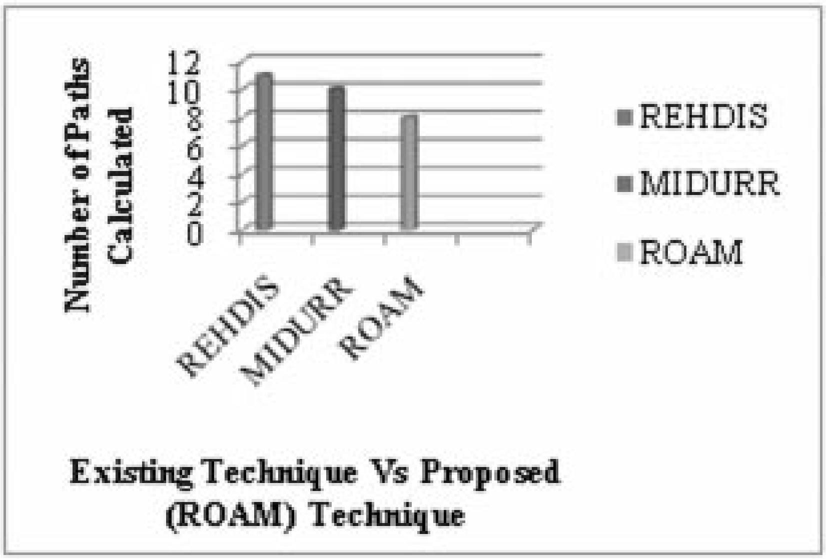

Figure 2: Comparison between Existing and ROAM Technique

The proposed ROAM gives first priority to the paths which passes through node 'F'. There are eight paths available as shown in Table 3. And prioritize the paths based on delay parameter. If more than one path has same delay, it checks hop count of the path. Also, if the paths have equal number of hop count and delay then it selects the path which is calculated first in the routing table.

Figure 2 shows the comparison among REHDIS, MIDURR and ROAM techniques. It clearly shows that the proposed ROAM takes minimum computations when compared with existing techniques. REHDIS computes 11 entries, MIDURR calculates 10 entries respectively. But in ROAM technique, it computes only 8 paths in the routing table.

5. CONCLUSION

This paper has proposed ROAM technique to reduce number of routing entries in the routing table and compared it with existing approaches. The result shows that ROAM greatly reduce routing overhead in routing table. In turn, it computes the route very quickly. The main aim of this paper is to enhance the performance of network by identifying path quickly with minimum computations. Though, ROAM has some advantages it has demerits such as transmitting data packets through a common node can become the bottleneck of transmission and also it does not suite for network that has maximum number of distinct paths.

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